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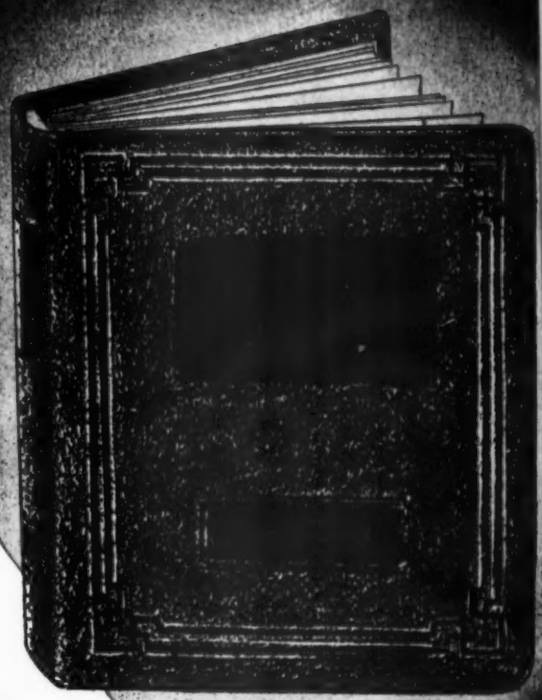

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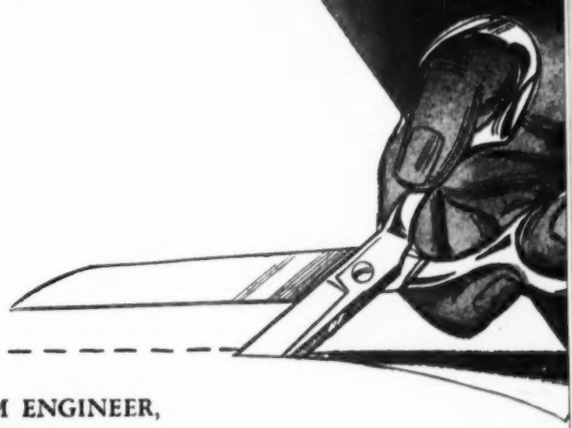

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THE Petroleum Engineer

DECEMBER 1938

VOLUME X NUMBER 3

A MAGAZINE OF METHODS FOR OPERATING MEN

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MEETINGS

California Natural Gasoline Association—January 5, Richfield Building, Los Angeles, California.

•

Society of Automotive Engineers, Annual Meeting — January 9, 10, 11, 12, and 13, Detroit, Michigan.

•

Indiana Independent Petroleum Association, Spring Convention and Refiners' and Suppliers' Exhibit—March 14, 15, and 16, Hotel Severin, Indianapolis, Indiana.

•

American Association of Petroleum Geologists—March 22, 23, and 24, Oklahoma City, Oklahoma.

•

American Chemical Society—April 3, 4, 5, 6, and 7, Baltimore, Maryland.

•

Oil-World Exposition — April 24, 25, 26, 27, 28, and 29, Houston, Texas.

•

Petroleum Industry Electrical Association—May 2, 3, and 4, Rice Hotel, Houston, Texas.

•

Petroleum Electric Supply Association—May 2, 3, and 4, Houston, Texas.

•

Natural Gasoline Association of America—May 3, 4, and 5, Tulsa, Oklahoma.

•

Pennsylvania Grade Crude Oil Association—June 15 and 16, Hotel Hershey, Hershey, Pennsylvania.

•

International Petroleum Exposition—May 18, 19, 20, 21, 22, 23, 24, and 25, 1940, Tulsa, Oklahoma.

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THE CONTINENTAL SUPPLY COMPANY

The Course of Oil

By K. C. SCLATER

Maximum Field Allowables

In an effort to find an effective means of stamping out excessive drilling in proved fields, the Railroad Commission of Texas is believed to be giving serious thought to the plan of setting a maximum allowable for each field. It was the opinion of many of the oil company executives at the Texas Railroad Commission December hearing in Austin, that such a plan would be effective in putting a stop to this wasteful practice.

Experience shows that the greater the number of wells in a field the harder it is to enforce proration. A good example of this is the East Texas field. Despite the benefits obtained from proration in that field, there has never been a time in its history when some operator was not clamoring for higher allowables.

Setting a maximum field allowable, based on reservoir conditions, would be one way of curing the evil.

●

Catalytic Refining Processes

Has the refining branch of the industry entered upon a new era of technological progress? There are indications that it has. New catalytic processes have recently been developed that, compared with existing modern refining practices, are revolutionary in the scope and flexibility of their operation. Known as the Houdry catalytic processes, they comprise complete catalytic operations for producing motor fuels and aviation gasolines by cracking gas oils, residuums, and crude oils either with or without the simultaneous production of fuel oils, and permit the use of a wide variety of crude oils.

As the ratio of heating fuel oil to gasoline produced from a barrel of crude oil can be controlled to any degree desired, a better economic balance can be achieved than under present practice. Refining operations can be adjusted to meet seasonal variations in the demand for petroleum products. The ability thus to manufacture gasoline or fuel oil to meet the seasonal demand will reduce the necessity of carrying excessive stocks of oil.

There are three units in operation using this process of 2000 barrels, 3000 barrels, and 15,000 barrels a day capacity, respectively. It is also reported that there are now under construction in the United States at a total cost of thirty-five million dollars, eleven plants, which when completed will be capable of producing 1,000,000 gallons of high octane gasoline a day.

The processes include also the catalytic treatment of gases for the removal of sulphur.

Should the adoption of these new processes become general, many types of crude oil that are now considered unsuitable for processing would be made available to the refiner. This should result eventually in a lessening of the demand for special crudes by refiners and so reduce selective buying in the field, a discriminating practice that sometimes leads to inequalities between fields that are prorated.

From what has already been learned of the Houdry catalytic processes, it appears that they have a tremendous economic significance. The development of these processes to their present commercial status constitutes a brilliant achievement that, besides ushering in a new era of technical development, may profoundly influence modern refining practice.

●

Encouraging Voluntary Cooperation

Not in many years has the statistical position of the American petroleum industry been so sound as it is at present. Crude oil stocks are lower than they have been for many years. They are not, if any at all, much in excess of requirements. There was remarkably close agreement on this point among oil company executives who attended the December monthly hearing at Austin, Texas, at the invitation of the Texas Railroad Commission.

If the industry is to take full advantage of this favorable position, it must maintain production in reasonable balance with consumption.

The problem of maintaining runs to stills at a level that will not cause gasoline stocks to become too top-heavy by early spring is one that confronts the industry about this time of the year. At this meeting satisfactory progress was made toward a voluntary solution of this problem within the industry—thanks to the efforts of Chairman E. O. Thompson of the Railroad Commission in calling leaders of the industry together as he did.

The consensus of the leaders present was that present crude stocks of 270,000,000 barrels were not excessive, and that 250,000,000 barrels was probably adequate for requirements.

In the opinion of the majority of the oil company executives present, gasoline stocks, now 70,000,000 barrels, should not be allowed to exceed 82,000,000 barrels. Cooperation toward this end was offered by the company executives.

This gathering of executives was notable for the spirit of cooperation that it engendered. Voluntary, open action of this kind on the part of oil company executives in cooperation with state officials should be encouraged. It paves the way for further voluntary joint action when common problems affecting both the State and the industry are confronted.

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« « HIGHLIGHTS IN OILDOM » »

Oklahoma's Well-Spacing Law Upheld

The United States Supreme Court on December 8 indicated the appeal of Russell B. Patterson from a decision of the Oklahoma Supreme Court upholding the validity of the state's well-spacing law would be dismissed. After Patterson's attorney had presented grounds for challenging the law the court refused to hear attorneys for the state present an oral defense of the measure, and such action almost invariably indicates dismissal of an appeal.

In a suit against the Stanolind Oil and Gas Company and the Amerada Petroleum Corporation, Patterson challenged the act, which authorizes the Oklahoma Corporation Commission to prescribe well-spacing and drilling-unit regulations.

In presenting his case to the United States Supreme Court, R. J. Roberts, attorney for Patterson, declared his client was deprived of about one-third his royalty on a Lincoln County lease when six and one-fourth of his acres were combined with three and three-fourths acres owned by another party to form a 10-acre spacing unit. Roberts termed the commission's well-spacing order "unreasonable." He attacked the state law on the grounds that it deprived Patterson of his property in violation of constitutional guarantees of due process.

●

Bill to Control Core Drilling is Proposed in Kansas

If a bill to be submitted to the 1939 session of the Kansas Legislature becomes law all core or test-well drilling in the state for oil and gas will be regulated. The legislative council has adopted a measure that will be presented to the entire legislative body in January. The proposed law would make it unlawful for any person to drill a test well in Kansas except upon approval by the State Corporation Commission of a license, bond for one year of not less than $500 nor more than $10,000, and payment of an application fee of $10. Violation of the act or other regulatory rules of law promulgated by the commission for the purpose of enforcement would be deemed a misdemeanor, and, upon conviction, be punishable by a fine of not less than $100 nor more than $500, or by imprisonment of not less than 30 days nor more than six months, or both.

The Corporation Commission would be empowered to have its agents inspect any test well at any time to determine if it were being drilled, or had been properly drilled or plugged. No licensee would be released from his bond until the state geologist certified that he had complied with the law.

●

Exploratory Concession in Iraq Approved

An oil concession by the Iraq government to the Basrah Petroleum Company has been approved by the Iraq senate and King Ghazi. The Basrah Petroleum Company was organized recently by British interests, and has a capital of $5,000,000. Its stockholders also include French interests and the Near East Development Corporation, which represents American investors.

The concession gives the company exclusive rights for 79 years to search for and extract oil from southern Iraq where there is no conflict with similar rights granted other companies.

Under the terms of the concession the Basrah Petroleum Company must begin drilling within three years and export oil within seven and one-half years, paying Iraq an annual rental of about $1,000,000 until it begins exporting oil. Thenceforth it must pay a royalty of four shillings ($1.00) per ton of oil produced subject to a minimum of $1,000,000. Iraq also is to receive free 20 percent of all oil produced and not exported.

●

Petroleum Exports in Sharp Increase

United States Department of Commerce figures disclose a sharp increase in American exports of natural gasoline and crude petroleum, attributable in part to world armament. The first nine months of this year 4,344,000 bbl. of natural gasoline was exported, 74 percent more than during the first nine months of last year. Exports of crude petroleum increased 23 percent to 60,006,000 barrels.

Japan tripled its purchases of natural gasoline, France doubled its purchases, and Russia, Spain, and Italy, which bought no gasoline here last year, made initial orders.

The Netherland West Indies, a transshipment point, was the destination of the largest quantity of natural gasoline. Shipments were 1,266,671 bbl., almost twice the shipments the first nine months of 1937. England and Canada, the next two largest purchasers, also increased their buying.

Leading purchasers of crude petroleum continued to be Canada, Japan, and France, although Japan and France bought less than in 1937.

Japan and Germany purchased increased quantities of gas oil. Japan reduced its purchases of fuel oil but was still the largest purchaser of this product, Chile and Cuba being next.

●

California Producers Alarmed at Large Storage Stocks

First efforts of independent oil producers of California to avert a possible market collapse resulting from constant additions of oil to storage were made at a statewide mass meeting in Bakersfield December 13. The meeting was open to all interested parties whether engaged in the oil industry or not and open discussion was held to determine ways and means of reducing California's production to 60,000 bbl. per day by January 1.

Continued additions to storage, which have been 92,200 bbl. per day since the first of the year, will result in chaos to the state's oil industry, informed oilmen have stated, and will offer an opening for the government to step in and control California oil production.

●

To Search for Oil in Denmark

Sole rights to explore and develop Danish soil for the next ten years in search of crude petroleum has been granted a large American petroleum corporation by the Danish government, it has been announced by the office of the American commercial attache at Copenhagen in a report to the Department of Commerce at Washington, D. C. At present Denmark is virtually dependent on foreign countries for its supply of motor fuel.

The name of the American company receiving the concession was not disclosed.

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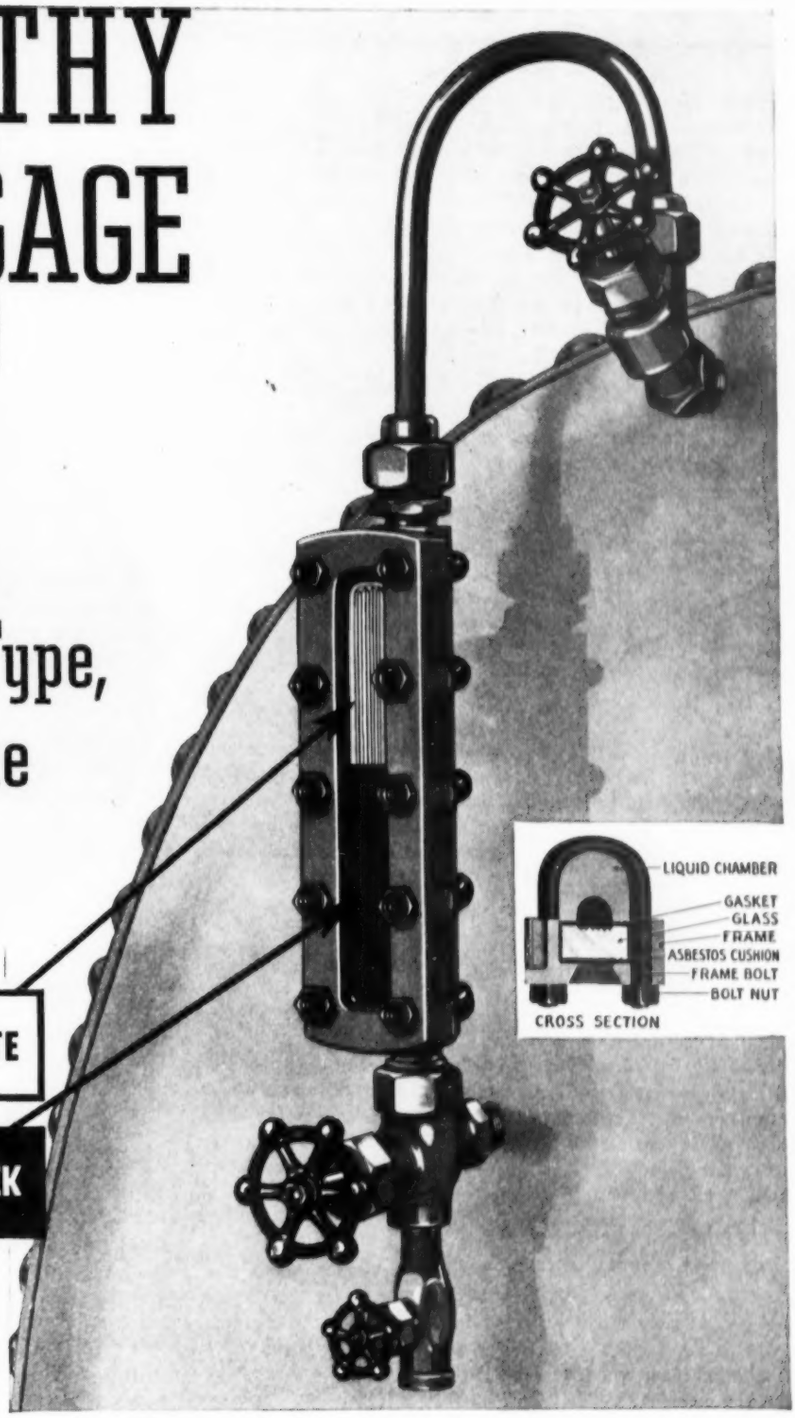

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Progress of Major Pipe Line Work

THE 70-mile pipe line from the Lake Centralia field, Marion County, Illinois, to The Texas Company's refinery at Lawrenceville has been completed. The line is a combination 8 in. and 10 inch. Williams Brothers Construction Company was the general contractor and the H. C. Price Company was subcontractor for the welding.

It has been announced also that Williams Brothers Construction Company has been awarded a contract to lay a 19-mile, 6-in. extension to this line. The new line will extend from Boyleston in southern Wayne County northeastward to tie-in with the line to Lawrenceville.

●

Carnegie Natural Gas Company, Pittsburgh, Pennsylvania, has contracted for the laying of a gas line from the new gas development on Chestnut Ridge, Fayette County, Pennsylvania, to connect with the company's system a mile east of Waynesboro. The line will be 27 miles in length and will be constructed of 8-in. seamless pipe. The general contractors for the job are Rich and Company, Bradford, Pennsylvania.

Because of the high rock pressure of the wells in the Chestnut Ridge area no additional stations will be necessary.

●

The Magnolia Pipe Line Company of Illinois, a new subsidiary of the Magnolia Petroleum Company, has purchased the 24-mile, 6-in. oil line of the Sinclair Refining Company from Wood River to East St. Louis, Illinois. The line will be utilized to transport crude from the Lake Centralia-Salem, Illinois, district to the Lubrite Refining Corporation's refinery at East St. Louis. The oil will be transported to Wood River through the Illinois Pipe Line Company's line.

●

Manly Oil Corporation is now operating its new 13-mile pipe line from the Lake Centralia-Salem field, Marion County, Illinois, to Centralia. The capacity of the line is 8000 bbl. per day. The line originates on the Young School lease in section 20-2n-2e, runs southward to the Green Street road, and westward to Centralia. Present plans are to extend the line to the Young Church lease. Eventually the system will extend approximately 20 miles.

●

The Phillips Petroleum Company and the Standish Pipe Line Company have completed arrangements for a 14-mile, 6-in. oil line from the Schuler field, Union County, Arkansas, to the Atlas Pipe Line Company's station at Cornie, Arkansas. The right-of-way has been purchased.

●

Southwest General Pipe Line Company, Dallas, Texas, has begun construction of a 21-mile, 6-in. gas trunk line from the Tomball field, Texas, to a point near Prairie View to connect with the Southern Union Utilities, Inc.'s 6-in. line that supplies numerous towns in the area with natural gas. The Southwest General Pipe Line Company and the Southern Union Utilities, Inc., are both subsidiaries of the Southern Union Gas Company.

●

An 18-mile, 4-in. oil line is being laid by the Comanche Pipe Line Corporation, Midland, Texas, from the Pecos Valley area in Pecos County, Texas, to Grand Falls in Ward County. At the latter point the line will connect with the system of the Atlantic Pipe Line Company. The Comanche Pipe Line Corporation now has a 2-in. line from Pecos Valley to Grand Falls, but an increased number of wells and increased production have made it inadequate. This line will be taken up and the pipe used to lay a 13-mile line from the company's Pecos Valley booster station to the Masterson pool.

●

The Simrall Corporation, affiliate of the Standard Oil Company of Ohio, has purchased the gathering system of the Arenac Pipe Line Company in the Clayton-Arenac field, Michigan.

●

The Champlin Refining Company's 12-mile oil line from its refinery at Enid, Oklahoma, to the new Hillsdale pool, northwest Garfield County, Oklahoma, has been completed. The Champlin Refining Company's No. 1 Boehm was the discovery well in the field and until this pipe line was completed it was necessary to truck production to the refinery at Enid. Two other tests are now being drilled in the area.

●

According to word received from Washington, D. C., the Northern Natural Gas Company has withdrawn its objection to construction by the Kansas Pipe Line and Gas Company of a $21,470,000 gas line from Kansas into Nebraska, the Dakotas, and Minnesota.

●

The Sinclair Refining Company has sold to the Petroleum Products Company, Chanute, Kansas, approximately 105 miles of pipe line gathering system in the southeastern Kansas stripper well area. The Petroleum Products Company is a producing, refining, and marketing organization. The company has a 1000-bbl. refinery at Chanute and will take about 800 bbl. of crude per day from the area.

●

The Cosden Pipe Line Company has begun the laying of a 4-in. oil line from the Ramsey pool, Payne County, Oklahoma, to Cushing, a distance of 21 miles. The announcement was made the early part of the month by J. A. Beyhan, superintendent of the company, who also stated that Williams Brothers Construction Company, Tulsa, Oklahoma, has been awarded the general contract.

At Cushing the new line will connect with the main Cushing-Drumright system of the Cosden company, which transports crude to the Mid-Continent Petroleum Corporation's refinery at Tulsa.

One river crossing will be necessary. Near Ripley the Cimarron River will be crossed with a 6-in. line. The project includes the erection of a pumping station in the field in which Gaso-Waukesha engines and Gaso pumping units will be installed.

●

Truman and Smith Construction Company, Eldorado, Kansas, are laying five miles of 10-in. pipe and two miles of 12-in. pipe for The Texas-Empire Pipe Line Company from Oil Hill to Valley Center, Kansas. The line will replace a 12-in. carrier.

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Latest Activities In The Oil Fields

REDDITT and Gray (Pundt and Cope) No. 2 Pickering, Childers Survey, Joaquin area, Shelby County, Texas, flowed 20,000,000 cu. ft. of gas and some distillate but, unlike wells previously drilled in the area, also produced some crude oil. Total depth of the well is 5115 ft. and 7-in. casing is set at a depth of 5080 ft. and perforated by 20 shots between 5053 and 5060 feet.

●

Union Producing Company's No. 1 Minnie Brown, in the Agua Dulca area, Nueces County, Texas, is now the deepest well ever drilled in Texas, having passed the 12,786-ft. previous record the first of December. Casing has been set at a depth of 8007 feet. The operators intend to drill to a total depth of about 14,000 feet.

●

The Texas Company's No. 1 Laterre, LaFourche Parish, Louisiana, flowed at the rate of 1094 bbl. of 38-deg. gravity oil per day through a 3/8-in. choke. Casing is perforated at a depth of 8500 to 8520 feet. This well opens a new pool.

●

Shell Petroleum Corporation's No. 1 Hazel Burdin, two miles west of Lake Verret, St. Martin Parish, Louisiana, produced at the rate of 160 bbl. per day, opening another new field.

●

Westmount Oil Company's No. 1 Amerada-State, in section 12-17s-36e, six miles south and two miles east of Lovington, New Mexico, produced dry, sweet gas from a total depth of 3986 ft., the amount being gauged at 13,000,000 cu. ft. per day. The 5½-in. casing was set at a depth of 3018 ft. and cemented with 400 sacks of cement, inside the 8⅝-in. casing.

●

Olson Oil Company's No. 1 Osage, in section 24-26-4e, west of the Burbank field in Kay County, Oklahoma, flowed oil and gas from a total depth of 3101 feet. Casing was set and cemented at a depth of 3096 ft. and the plug was being drilled when the well blew-in. The volume of gas is estimated to be 7,000,000 cu. ft. per day.

●

Longhorn Drilling Corporation's No. 1 M. M. Miller, in section 28, Ball subdivision, Flores grant, Duval County, Texas, flowed 203 bbl. of oil per day through 5/32-in. choke from the Gravis sand at a depth of 4893 to 4899 feet. Tubing pressure was 780 lb. and casing pressure 1000 pounds. The well is one and three-fourths miles southwest of the old Sweden field and may be an extension but seems to be a separate area.

●

John E. Mabee's No. 1-D Coline Oil Company-Willard, one and one-fourth miles southwest of the nearest producing well in the Bennett field and four miles northeast of the nearest producing well in the Denver pool, Yoakum County, Texas, flowed 320 bbl. of oil per day naturally through 2-in. tubing from a total depth of 5227 ft., and after treatment with 1500 gal. of acid it flowed at the rate of 25 bbl. per hour. After a second stage of 4000 gal. the potential production was 2840 bbl. per day. The well is important because it indicates that the Bennett and Denver pools are one continuous field.

●

Richfield Oil Corporation's No. 1 K. C. L.-Western, four miles west of the Ten Section field and one mile east of the Elk Hills field, California, flowed 3750 bbl. of oil and 18,000,000 cu. ft. of gas per day from a formation believed to be the Stevens zone at a depth of 8677 feet. The 8⅝-in. casing is set at a depth of 8406 ft., and 339 ft. of 4¾-in. liner is set at a depth of 8676 feet. The discovery followed only a few days after the Ohio Oil Company's No. 1-F K. C. L., about one and one-half miles farther south, flowed 825 bbl. of oil and 5,710,000 cu. ft. of gas from the same zone at a depth of 9365 feet. The 8⅝-in. casing is set at a depth of 9220 ft. and 171 ft. of 4¾-in. liner is set at a depth of 9364 feet. The two wells are drilled on different structures.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70- .90
Signal Hill	.80-1.21
Montana	.90-1.35
Wyoming	.35-1.30
Colorado	.92-1.25
New Mexico	.53- .95
Texas	
North Central	.71-1.03
Panhandle	.67- .96
West Texas	.53- .95
Gulf Coast	.79-1.28
Darst Creek	.96
East Texas	1.10
Talco	.55
Kansas	.60-1.10
Oklahoma	.60-1.10
Arkansas	.66-1.05
Louisiana	
Rodessa	$ 1.05
Gulf Coast	.74-1.20
North Louisiana	.73-1.05
Illinois	1.05-1.15
Kentucky	1.10-1.40
Indiana	1.05
Ohio	
Lima	.90
Michigan	.74-92.5
Pennsylvania	
Bradford	1.68
Southwest	1.34
Eureka	1.28
Buckeye	1.18
Corning	.97
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	[1]B. of M. Calculated Requirements (December)	Week Ended Dec. 3, 1938	Week Ended Oct. 29, 1938	Week Ended Dec. 4, 1937
Oklahoma	500,700	417,550	432,000	556,100
Kansas	159,000	148,350	157,100	168,800
Panhandle Texas	.....	62,350	60,100	67,700
North Texas	.....	73,950	79,800	72,350
West Central Texas	.....	30,200	31,850	33,450
West Texas	.....	205,950	200,200	190,050
East Central Texas	.....	90,950	90,550	91,400
East Texas	.....	371,150	370,050	416,900
Southwest Texas	.....	226,300	224,500	240,600
Coastal Louisiana	.....	211,950	203,600	191,900
TOTAL TEXAS	1,343,900	1,272,800	1,260,650	1,304,350
North Louisiana	.....	72,550	75,450	74,900
Coastal Louisiana	.....	188,350	194,200	171,400
TOTAL LA.	248,000	260,900	269,650	246,300
Arkansas	51,600	48,600	49,200	44,100
Eastern	169,000	200,850	183,800	137,000
Michigan	51,000	50,650	53,850	53,750
Wyoming	76,100	53,400	51,350	48,700
Montana	12,600	12,050	13,500	15,750
Colorado	3,900	3,600	3,950	4,300
New Mexico	100,300	108,200	103,500	104,750
TOTAL EAST OF CALIF.	2,716,100	2,576,950	2,578,550	2,683,900
California	589,700	646,700	659,000	703,100
TOTAL U. S.	3,305,800	3,223,650	3,237,550	3,387,000

[1]These are Bureau of Mines' calculations of the requirements of domestic crude oil based upon certain premises outlined in its detailed forecast for the month of December. As requirements may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil inventories must be deducted from the Bureau's estimated requirements to determine the amount of new crude to be produced.

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Dowell Formation Plug is the result of several years of intensive research. It has already proved its great value in numerous applications. As a saver of time, tools, labor and money it is one of the most useful services Dowell has ever developed.

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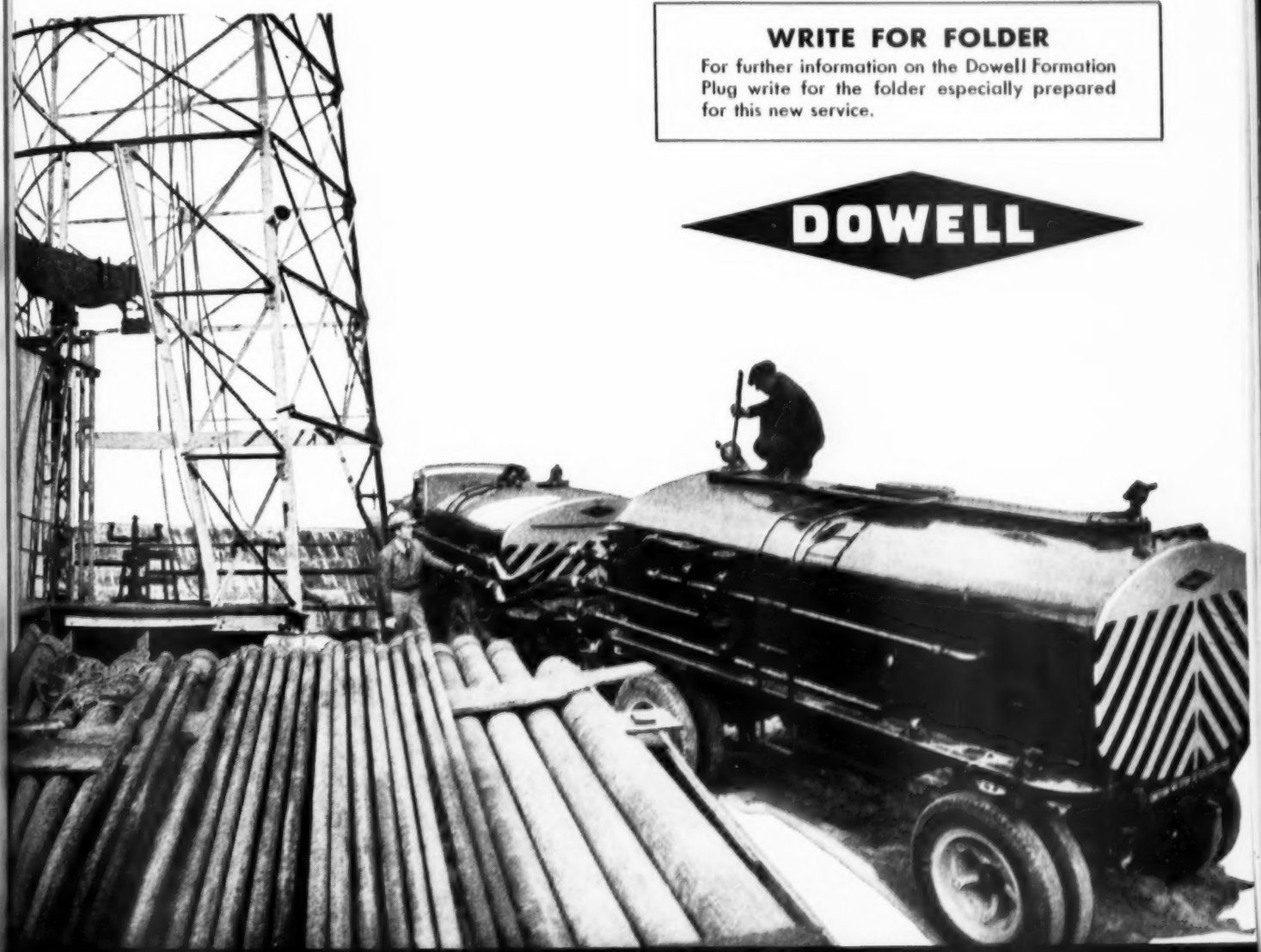
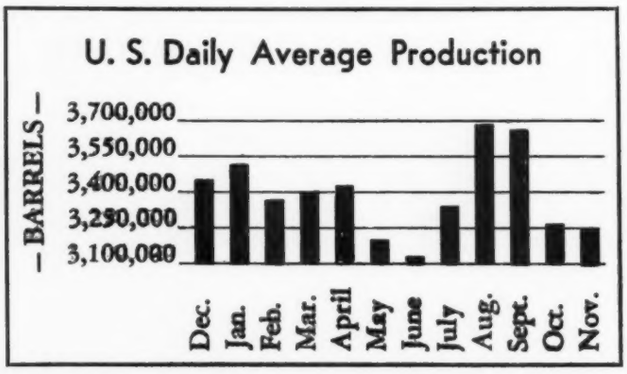
For further information on the Dowell Formation Plug write for the folder especially prepared for this new service.

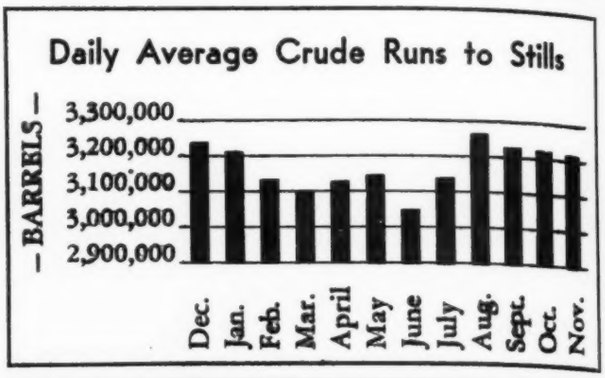
DOWELL

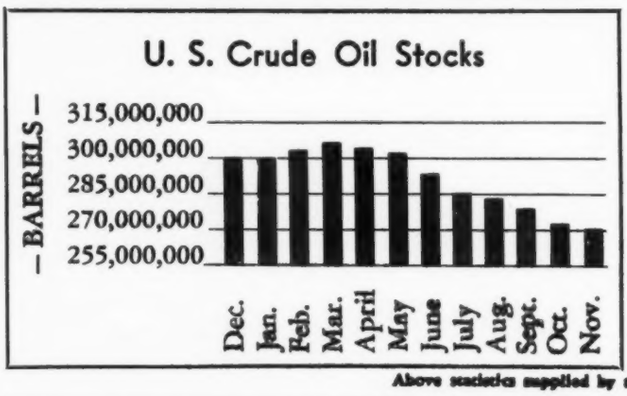


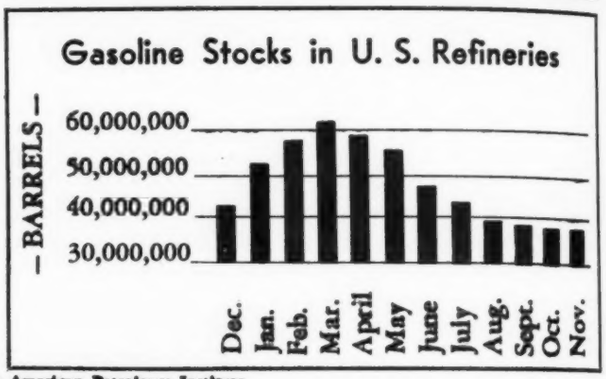
OIL AND GAS WELL CHEMICAL SERVICE

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for November, 1938

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	81	80	18	35	3500-3700	2	40	Rotary
Duval County	74	56	7	22	1584-2000	2	22	Rotary
Ector County	45	44	7	59	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	43	43	30	119	1700-3900	2	40	Rotary
Refugio County	20	17	3	12	4900-5900	2	38	Rotary
Nueces County	24	23	5	16	3922-5878	2 or 3	21-54	Rotary
Winkler County	17	16	2	14	2850-3450	2 and 3	30-38	Rot.-Cab.
K. M. A. Field	30	29	23	37	3730-3935	2	42-43	Rot.-Cab.
Oklahoma								
Oklahoma City	7	4	3	8	6450-6682	3	39	Rotary
Fitts Pool	9	9	2	5	1800-4458	2 or 3	38	Rotary
Kansas								
Russell County	14	13	4	21	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	13	9	3	15	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	22	17	4	18	3290-3518	2	39-42	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	6	6	4	9	5950-6450	3	39	Rotary
Illinois								
Central Illinois	431	341	67	444	2950-4100	2	36-38	Rot.-Cab.
New Mexico								
Lea County	38	32	10	83	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	4	4	1	8	8300-8730	3 or 4	40	Rotary
Wilmington	11	11	9	7	3500-4060	2 and 3	18-20	Rotary

Field Activities by States for November, 1938

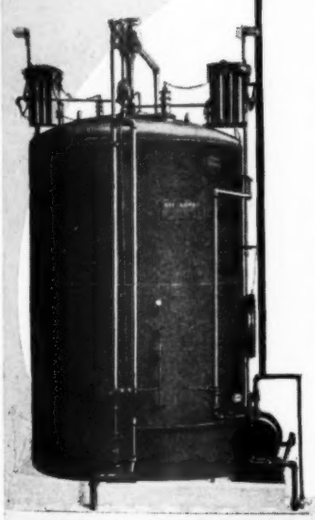
State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1937 (In Barrels)
	November	October	November	October	November	October	November	October	November	October	
Arkansas	17	21	16	20	26	17	16	14	36	34	12,088,341
California	118	100	91	83	39	83	82	95	163	207	238,587,662
Colorado	4	0	3	0	....	....	2	4	29	26	1,532,893
Illinois	430	431	341	345	....	....	320	317**	160	155	7,376,022
Indiana	29	28	13	20	....	....	2	3	41	42	820,000
Kansas	114	150	87	120	63	122	20	30	165	178	70,842,000
Kentucky	83	88	63	49	....	....	6	8	115	111	5,500,000
Louisiana	88	94	56	66	75	122	47	51	175	183	90,501,068
Michigan	128	113	90	64	113	85	21	20	110	106	16,254,181
Mississippi	5	3	1	1	....	....	6	5	4	3	Gas Prod.
Montana	7	11	4	9	....	....	3	4	46	52	5,775,000
New Mexico	44	45	36	41	....	....	15	16	130	116	38,642,184
New York	56*	61*	52*	50*	....	....	....	....	....	....	5,486,200
Ohio	75	70	58	49	....	....	43	37	139	113	3,547,600
Oklahoma	154	174	124	116	108	188	39	45	259	273	225,402,731
Pennsylvania	123*	143*	116*	128*	....	....	....	....	....	....	19,134,400
Texas	879	970	673	745	879	798	257	271	992	994	506,891,223
West Virginia	62	76	56	70	....	....	26	25	119	124	3,833,000
Wyoming	12	13	8	8	....	....	5	6	55	63	19,402,121
Total	2428	2591	1888	1984	1303	1415	910	951	2738	2780	1,271,316,687

*Includes water-intake and pressure wells.
**Includes 92 rigging-up and 225 rigs standing.

VOLUME LOSSES

REACH *Staggering* PROPORTIONS WHEN CONVERTED INTO DOLLARS

2%



Two per cent is authoritatively stated to be a conservative estimate of the average volume losses from well to refinery in the production and handling of crude oil. In terms of percentage these losses may appear to have little significance. When converted into dollars they merit the careful consideration of even the smallest producer.

An average volume loss of two per cent would amount to **$25,282,342.** when figured at an arbitrary price of **$1.00** per barrel on the total U. S. crude production for 1937, and an annual loss of **$3,650.** for a single well producing 500 barrels a day.

Producers of crude in any quantity will find a careful check of gravity and volume losses of utmost importance. They also will be vitally interested in the fact that Petreco Electromatic Dehydration saves both the gravity **and** volume of "cut" crudes as no other treating method can do. Petreco engineers are available at all times for assistance in making preliminary investigations and tests for determining gravity and volume losses without cost or obligation.

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The Month's Activities in Refining

Percent Refining Capacity Operated

Western Division, 69.2 Percent **Central Division, 77.4 Percent** **Eastern Division, 80.0 Percent**

THE Swedish Government has authorized the appropriation of Kr. 6,000,000 to the Rederi AB. Nordstjernan Stockholm, for the construction of a new refinery at Nynashamn, Sweden. The same company operates the only petroleum refinery in Sweden, situated at Nynashamn, and is the only importer of crude oil in any considerable quantities.

●

The plant of the Barnsdall Refining Company at Barnsdall, Oklahoma, after being shut down since October 12, resumed operations December 1st. The refinery has a capacity for 5000 bbl. of crude oil per day and facilities for cracking 2500 bbl. per day.

●

A presidential decree has authorized the Y.P.F., state oil fields department of Argentina, to construct a combined topping, cracking, and polymerization unit at its La Plata refinery. This will be the first polymerization unit in Argentina. The cost of the new installation is estimated at 7,350-000 pesos.

●

Philip N. Faine, secretary of the Ohio Pennsylvania Grade Oil Producers Association, announces that owing to several reductions in prices of crude oil since last January plans are in progress for the construction of a 1500-bbl. refinery at Zanesville, Ohio, by producers to refine Buckeye crude. The refinery will be constructed and operated by the Zane Refining Company, the principals of which are members of the Ohio Pennsylvania Grade Oil Producers Association. The plant will be situated along the Muskingum River.

●

F. C. Henderson, New York City, and J. Wood Glass, Nowata, Oklahoma, announce a new gasoline plant for Agua Dulce, Nueces County, Texas, to be completed by the last of January. The capacity of the plant will be 60,000,-000 cu. ft. per day, manufacturing 48,000 gal. of gasoline per day. Residue gas will be utilized for repressuring.

Roeser and Pendleton, Inc., Fort Worth, Texas, has been granted permission by the Texas Railroad Commission to construct a gas recycling plant in the Cayuga field. Gas will be taken from the Trinity formation, the gasoline content extracted, and the Woodbine zone repressured with the residue gas.

●

The Barnsdall Oil Corporation has completed the rebuilding of its gasoline plant in the Foster field, near Odessa, Texas, and has placed it in operation. Revamping was necessitated by damage to the plant by fire. The capacity of the plant has been increased by the addition of two 230-hp. gas-engine-driven compressors and another stabilizing tower.

●

Mankins Oil and Refining Company has completed its new refinery at Mankins, Archer County, Texas. The Mankins company is owned by the Cargo Oil Corporation of New York City. The capacity of the plant is 1500 bbl. per day, but for the present it will operate on 1000 bbl. per day. Crude oil supply is obtained from the K.M.A. field.

●

Successful drilling of the Dhulian field, India, has prompted directors of the Attock Oil Company to authorize the construction of a new refinery at Rawalpindi having a capacity of 3500 to 4000 bbl. of crude oil per day. The plant is expected to be completed by the last of 1939. The existing refinery at Rawalpindi will be used as an auxiliary unit.

Recently the production of the Dhulian field has been restricted owing to the limited capacity of the present refinery and lack of storage. The last well drilled in the field, in July, 1938, capable of producing 2200 bbl. per day had to be curtailed to 990 bbl. per day because of a lack of outlet.

●

The Portex Oil Company's recycling plant in Joaquin area, Shelby County, Texas, has been completed and placed in operation, obtaining gas from three Glenrose gas producers. The plant, which now has a capacity of 20,000,-000 cu. ft. of gas per day, will be enlarged to process 40,000,000 cu. ft. per day, officials of the company state.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks
Week Ending December 3, 1938

A.P.I. Figures
(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbls.	Gas and Fuel Oil Stocks Thousands of Bbls.
East Coast	100.0	491,000	79.8	18,037	15,675
Appalachian	85.9	94,000	73.4	2,876	741
Ind., Ill., Ky.	89.5	415,000	80.7	10,452	8,594
Okla., Kans., Mo.	81.6	256,000	74.9	6,169	4,592
Inland Texas	50.3	114,000	71.7	1,656	2,000
Texas Gulf	88.9	780,000	93.1	8,895	13,855
La. Gulf	97.3	129,000	89.0	2,181	2,712
No. La. & Ark.	55.0	32,000	58.2	409	888
Rocky Mt.	54.2	47,000	73.4	1,158	740
California	90.0	485,000	65.1	13,542	98,470
Reported	85.6	2,843,000	78.9	65,375	148,267
Estimated Unreported		332,000		3,780	3,350
*EST'D TOTAL U. S. DEC. 3, '38		3,175,000		69,155	151,617
*EST'D TOTAL U. S. NOV. 26, '38		3,295,000		68,736	153,634
U. S. B. of M. *DEC. 3, 1937		**3,173,000		71,244	119,836

*Estimated Bureau of Mines' basis.
**December, 1937, daily average.

THE Petroleum Engineer

DECEMBER, 1938

Advanced Casing-Welding Practice in California

High window in derrick of new design permits raising pre-welded two-joint stands onto derrick floor

By WALLACE A. SAWDON

Petroleum Engineer, Los Angeles, California

THE welding of surface strings has become the almost general practice of many operators in the California fields. The technique of welding pipe as it is being run into the well has therefore been improved during the last few years, and now welded casing of large diameter probably can be run more rapidly than threaded pipe. Welding of casing has been restricted mainly to surface strings; present practice does not indicate an immediate application of welding to pipe of smaller size but many operators believe that welded water strings may eventually become as general as welded surface strings now are. Both the speed and the facility of welding may be appreciably increased by the use of a derrick of a new type that has a high window. Two 40-ft. joints can be welded on the walk before being hauled onto the derrick floor through this window.

The chief advantages of welded casing are insurance against leakage at the joint, prevention of corrosion, and greater tensile strength. Some operators regard greater strength as the main objective of welding the casing, and estimate the tensile strength to be as much as 40 percent greater than that of the regular thread-and-coupled joint. The conclusions as to the increased strength of welded joints are based both upon full-joint pull-out tests and on tests of the tensile strength of coupons cut from the pipe.

The personal element enters into the making of the welds, however, and this factor must be taken into consideration. In the California fields the casing string is welded on the derrick floor by a company specializing in this practice. Employment of crews experienced in the operation provides the maximum insurance against variations in technique due to the personal element and probably has contributed to the success achieved in the welding of casing. The necessity for employing men trained to this particular kind of welding has been brought out by L. R. Hodell.[1]

All welds are now being made by electric arc and most crews consist of three men. Many short strings are welded by two men and the difference in total running time is unimportant when the depth to which the casing is run is not great. The time required for handling the pipe, stabbing, etc., remains the same no matter how many welders are employed, so it is sometimes more economical to hire only two men.

Casing is naturally welded while in a vertical position but if the high-window derrick is used, both vertical and horizontal welding are necessary. Two crews must then be used, one on the derrick floor to weld the two-joint

Unforeseen difficulties have necessitated the omission of The Petroleum Engineer's Continuous Tables from the December issue. The next installment will be published in the January issue, and the tables will appear regularly thereafter as usual.

[1] "Circumferential Field Welding of Casing" by L. R. Hodell, A.P.I. Drilling and Production Practice, 1937.

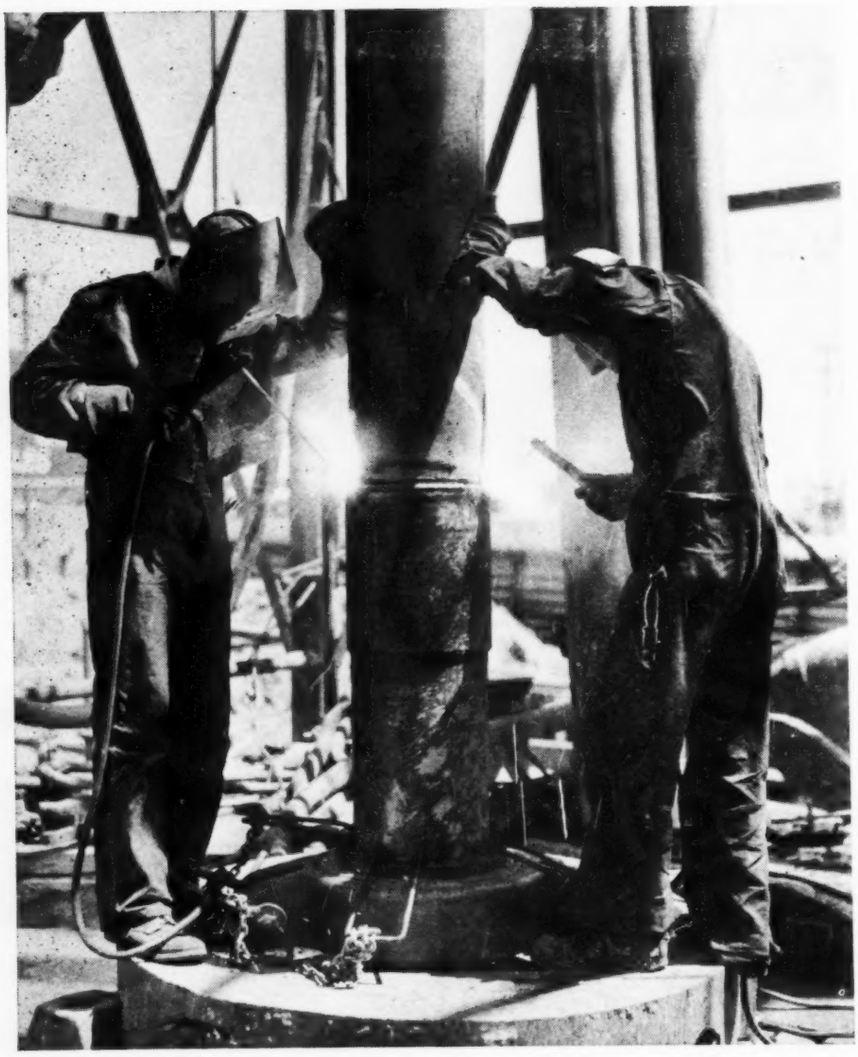


Fig. 1. Welding a sleeve joint on a surface string being run in a well in California

(Photo courtesy American Pipe and Steel Corp.)

stands as they go into the well, the other on the walk to weld two joints together to make a stand of approximately 80 ft., which can readily be hauled through the high window into the derrick. The joints can, of course, be welded into stands beforehand if desired; but whether they are so welded or are made up into two-joint stands while the string is being run, the objective is greater speed in running the pipe.

Welding of a stand in the rat-hole while the stands thus made are being welded in the hole has not been practiced in California. It is thought that little time can be saved by this method and that hazards are increased. There are too many men working in a small area. The joints making up the stand in the rat-hole must be handled while the stands themselves are hung above the hole. The rat-hole is inclined and lining-up is therefore more difficult.

Casing of diameters exceeding 10¾ in. is being welded. The 11¾-in. size is probably the dividing line for speed of welding, pipe of greater diameter being run faster by welding and that of smaller size being run faster if threaded-and-coupled. It is thought by some operators, however, that further development in welding technique possibly aided by such construction features as the high derrick window will increase the speed of welding of smaller pipe to equal or exceed that obtained by threaded-and-coupled joints.

Casing of the sleeve-joint type has been found to weld a little more rapidly than other welded types as a line-up clamp must be used on either the bell-and-spigot type or butt-welded pipe. Sleeve-joint pipe is being used most widely in California, although some companies prefer the bell-and-spigot joint. Butt-weld casing is seldom used for casing a hole at the present time, although the greater strength of this joint is well known. It is not as easily or quickly handled or lined-up on the derrick floor, however, and even if two-joint stands are made-up on the walk the stands must be welded together while in a vertical position as the string is run into the well. When one joint is welded on the walk it will probably be butt-welded no matter whether the joints welded on the floor are sleeve, bell-and-spigot, or other design.

Data of great value on the strength of welds, kinds of rods to use, effect of temperature and time, effect of welding on grain structure, bend tests, and the results of tests made on various types of joints have been compiled and published by L. R. Hodell[1] and Marvin Cook.[2] In Mr. Hodell's paper the necessity for using casing made of a steel that is readily weldable is emphasized. It is the writer's understanding that considerable progress has been made in this regard and that at the recent meeting of the A.P.I. in Chicago arrangements were made for marking pipe of weldable alloy with the letter "W" and that this practice will henceforth be followed. This marking will be used even on threaded pipe so that any such pipe that is later salvaged may be recognized and welded with full knowledge of its adaptability for welding.

Many full-joint pull-out tests have been made on welded joints of the various types now in vogue both in California and elsewhere. There is still a strong feeling among many operators that the butt weld will produce the greatest strength. Not all actual tests, however, indicate this to be true, although Mr. Hodell expressed the opinion that complete penetration was not obtained when making the butt welds that were submitted for the tests that he reported. Tests made for the American Pipe and Steel Corporation at the University of California by Raymond E. Davis, consulting engineer, probably indicate correctly the efficiency of different types of joints being made in California.

It must be emphasized that in the preparation of the joints for these tests no effort was made to produce perfect welds, because the intention was to make joints under present-day field conditions, which require considerable speed. All field joints were, of course, welded while the casing stood in a vertical position. The couplings prewelded to form the sleeve-type joint were welded at the shop. Seven specimens of arc-welded, oil-well casing joints made in 8⅝-in., 36-lb., Grade C casing were

[2] "Welded Joints for Oil-Well Casing" by Marvin Cook, A. P. I. Drilling and Production Practice, 1936.

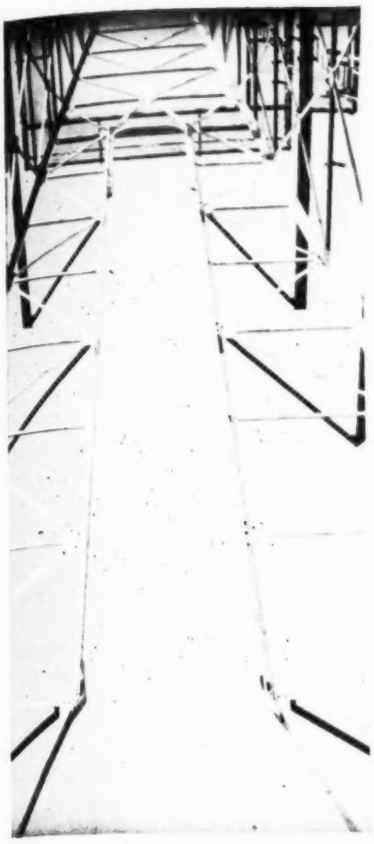


Fig. 2. This high window in a steel derrick of new design allows two 40-ft. joints of casing to be welded on the walk and the stand thus made to be hauled onto the derrick floor for welding into the well

tested. The welding rod used had a specified tensile strength of 85,000 lb. per sq. inch.

To determine the ultimate strength, yield point, and elongation value of the pipe material, two tensile strength coupons from each joint section were milled from each piece of casing after the specimens were ruptured. These coupons were cut from the extreme outer ends of the joint specimens at places not touched by the grips of the testing machine. As the stock was probably not stressed beyond the yield point of the material, the ultimate strength determined from it and the yield point and elongation values reported were probably not seriously in error. The ultimate strength of the weakest coupon for each welded joint was used.

Of the seven specimens tested, two were butt welds, two bell-end joints, and three sleeve-type joints. The joint efficiency based on the A.P.I. specification strength averaged 94.4 percent for the butt welds, 93.0 percent for the bell-end joints, and 94.9 percent for the sleeve-type joints.

Comparison of the efficiency of the three different types of joint on Grade C casing shows that they were very similar. Based on specification strength, the sleeve-type is slightly better than the butt joint or bell-end joint. Tests were also made of two butt welds on Grade D casing, but because the strength of the rod used was considerably lower than either the specified or minimum coupon strength of the Grade D casing, no conclusions could be drawn as to what joint efficiency would be produced by use of a rod better suited to welding pipe of this kind. Moreover, it is doubtful if very much pipe of present Grade D specifications will be used for welding.

It is emphasized that the welds of all specimens were made at the same speed under conditions as nearly like general field conditions as possible. Many tests that have been reported elsewhere indicate higher efficiencies and considerable advantage to one or another kind of joint. Proper welding of any kind of joint should produce satisfactory results, so that economy or objective may determine the type of joint to use.

It is rather difficult to prophesy to what extent or how soon casing of smaller size will be generally welded in California. It is also difficult to predict what type of joint will be most widely used. It is the opinion of some operators, however, that on the strings of large diameter the sleeve-type joint will continue to be used and on the smaller ones, the bell-end type will be used. The butt-welded joint does have the advantage of providing greater clearance and there may be many specific purposes for which it will be most desirable.

The speed of running welded casing naturally depends on the conditions in the hole as well as on the length of the string, size and weight of pipe, and experience of the crew. A rough average speed for running 13⅜-in. casing, which is the size most commonly used for surface strings in California, is between 3 and 3½ hours per 1000 feet. Many long strings have been welded and run more rapidly. A 4800-ft. string in a deep well at Long Beach required only 11 hours, approximately 2.3 hours per 1000 feet. The longest string yet run, 5087 ft. of 16-in., was run in a total elapsed time of 16 hours and 9 minutes, approximately 3.2 hours per 1000 feet. Many other comparatively long strings have been run at a rate less than 2 hours per 1000 ft., as more rapid progress is made in running the longer strings.

In welding casing into the well, two to four passes are being made, depending on the depth of the well and the weight of the pipe. Two passes are used on most short strings and at the bottom of some longer strings. Three passes usually suffice for moderately long strings but the upper joints of

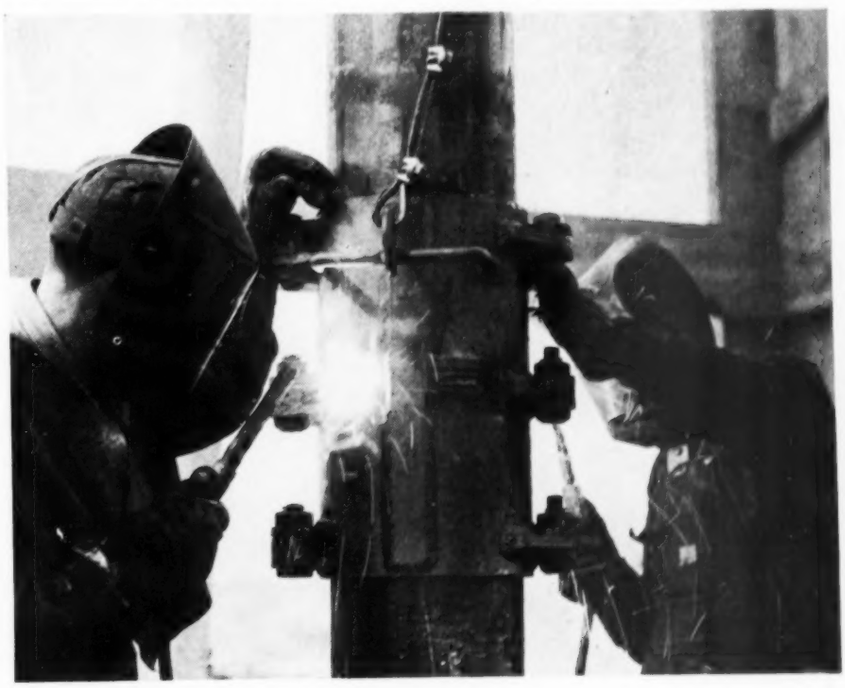


Fig. 3. This line-up clamp is used for butt-welding casing into the well. It provides for separation of the pipe to allow proper penetration. A variant of this design is used for lining-up bell-end joints

(Photo courtesy American Pipe and Steel Corp.)

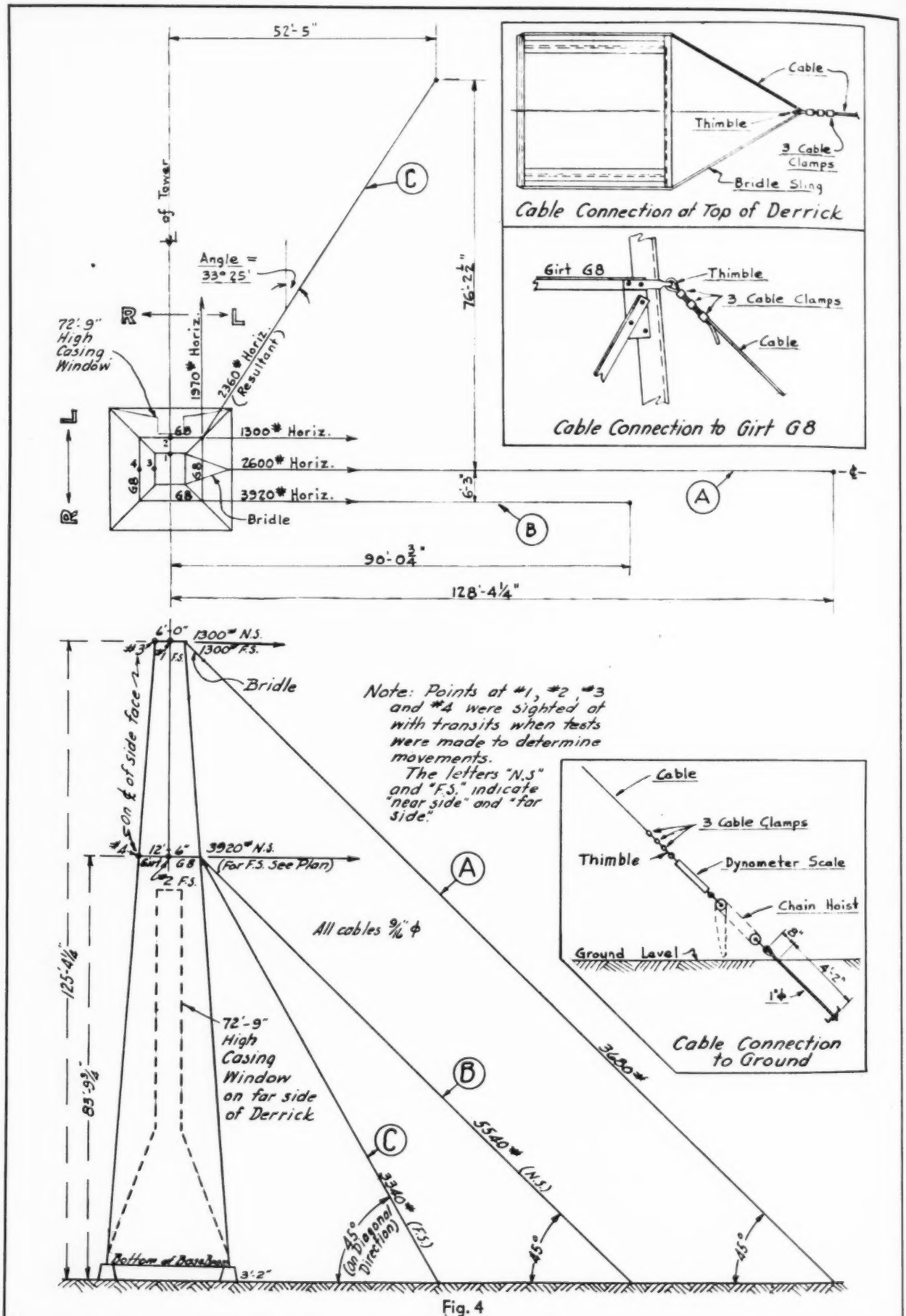

52'-5"
℄ of Tower
Angle = 33° 25'
72'-9" High Casing Window
1970# Horiz.
2360# Horiz. (Resultant)
76'-2½"
1300# Horiz.
2600# Horiz.
3920# Horiz.
Bridle
6'-3"
90'-0¾"
128'-4¼"
Cable
Thimble
3 Cable Clamps
Bridle Sling
Cable Connection at Top of Derrick
Girt G8
Thimble
3 Cable Clamps
Cable
Cable Connection to Girt G8
4'-0" 1300# N.S.
1300# F.S.
Bridle
Note: Points at #1, #2 #3 and #4 were sighted of with transits when tests were made to determine movements. The letters "N.S" and "F.S." indicate "near side" and "far side."
℄ on ℄ of side face
12'-6" 3920# N.S.
(For F.S. See Plan)
All cables 9/16" ϕ
125'-4½"
83'-9½"
72'-9" High Casing Window on far side of Derrick
3640#
5540# (N.S.)
3340# (F.S.)
45° (on Diagonal Direction)
45°
45°
Bottom of Boxing
3'-2"
Cable
3 Cable Clamps
Thimble
Dynometer Scale
Chain Hoist
Ground Level
4'-2"
1'-0"
Cable Connection to Ground

Fig. 4

many very long strings are made with four passes. The record string of 5087 ft. of 16-in. pipe run in Tide Water-Associated Oil Company's No. 27 V. L. & W. at Ventura consisted of 128 joints. Of these the lower 100 joints were made with three passes and the upper 28 joints with four passes. All joints were thoroughly peened after each pass.

One welding organization, however, seldom uses more than two beads on any string. This company asserts that a fixed amount of metal and proper penetration can give a weld of satisfactory strength and value if made properly, whether two beads or three or four are used. In fact, some short strings are welded with one bead. The making of the weld is a matter of technique and the experience of the operator doing the welding should be utilized to the fullest. The desire of the client naturally has a great influence and probably has caused the welding company to vary its procedure on some jobs against its wishes. The welding company, however, is relying on efficiency and quality of its work for its success and naturally is doing everything possible to advance the technique of welding casing.

Very few water strings have been welded in California during the last few years and there still seems to be little tendency toward the use of welded joints for such strings. In the Wilmington field some of the 11¾-in. strings were welded and the liners utilized for single- or multiple-zone production were set in them. Casing or float shoes and even float collars made-up on water strings of threaded casing, however, are generally spot welded or welded with a complete bead around the pipe. Shoes used on welded strings are always a slip-joint type and are welded to the pipe by the method used in making the joints.

Welded surface strings 1500 ft. or more in length are generally floated. A whirler shoe was used on the bottom and a float collar at the top of the first 40-ft. joint of the 5087-ft. string of 16-in. pipe mentioned. Normal floating-in practice was followed in running this string, although fluid was circulated for 6 to 14 minutes periodically after the first 37 joints were inserted. A stabbing board was erected approximately 40 ft. above the derrick floor and a hose was carried to it for convenience in putting mud fluid into the casing while it was being welded.

During welding the pipe is hung on elevators. The side-door casing elevator has been found advantageous to support casing provided with the sleeve-type joint, but some welding companies use a clamp below the shop-weld at the bottom of the sleeve. Two of these clamps are kept in operation during the job, one on the pipe suspended above the hole and the other on the joint or stand next to be hauled onto the derrick floor. These clamps have also been found adequate for use on casing provided with the bell-and-spigot type joint, as the design permits tightening below the bell to provide a shoulder for the elevator similar to a collar.

TABLE I
Derrick Tests

A.P.I. loading specifications	Pull in cable, lb.			Movement at points, in.			
	"A"	"B"	"C"	No. 1	No. 2	No. 3	No. 4
100%	3680	5540	3340	L-¼	L-⅜	R-¼	R-⅛
	"A" and "C" loads off			L-1/16	0	R-⅛	R-⅛
	All loads off			0	R-1/16	R-¼	R-⅛
150%	5520	8310	5010	L-⅝	L-⅝	R-⅛	R-1/16
200%	....	11,080	....	L-⅝	L-13/16	R-⅜	0

"A" load indicated on Edison direct-reading dynamometer.
"B" and "C" load indicated on Caltech. calibrated dynamometer.

Fig. 5. This float shoe has been centered ready for welding on the bottom of a string of casing that is to be welded into the hole. The float shoe is the 13⅜-in. slip-joint type

Butt-weld joints, although seldom used in California, require the use of the slip-type elevator and some type of spider in the table equipped with slips that set automatically. The extra precaution necessary in handling and running butt-welded casing increases the time required for welding and running the string.

All jobs must, of course, be made fireproof before welding operations are started. The experienced crews provided by companies specializing in welding casing are trained to guard against fire. Gas leakage must be avoided, and all oil in the cellar, around the derrick, or even on the ground nearby or in the mud pits must be removed. If the hole is properly filled with mud fluid there should be no danger from below ground under ordinary conditions. If the string is being set to exclude gas or oil, due attention must be paid to the hole, and any oil or gas flow immediately stopped.

To permit hauling long stands of casing into the derrick after the joints have been welded on the walk, a steel derrick of new design provided with a window 72 ft. 9 in. high has recently been developed. Stands 90 ft. long can easily be hauled through an opening of this height (Fig. 2).

As the high window cuts all the girts to the fourble board on one side of the derrick, the ability of the structure to resist torsional stresses had to be determined by the application of actual A.P.I. loadings. The derrick tested was 122 ft. in height and its base was 24 ft. square. It was designed by Buck and Stoddard, Inc., and made by Consolidated Steel Corporation. The

tests were made at the steel company's plant where the derrick had been erected.

Details of the procedure followed in making the tests are shown in Fig. 4. Three cables were used to apply the torsional stresses and the pulls were measured by three dynamometers, one placed at the end of each cable. The cables were connected through a chain hoist to a deadman as indicated in the drawing. Two of the dynamometers were borrowed from California Institute of Technology and were calibrated by Dr. Converse of that school. The third dynamometer was supplied by the California Edison Company, Ltd., and was the direct-reading type. All pulls were measured at an angle of 45 deg. from the ground by means of the chain block secured to the deadman.

The cable "A" was fastened to the top of the derrick by a bridle sling arranged as shown in Fig. 4. The pull was read on the dynamometer and the pull for A.P.I. specification loading was so calculated as to apply a horizontal load component at the top of the derrick equivalent to 1300 lb. at each termination of the bridle sling, or a total of 2600 lb. at the top of the derrick, which is equivalent to A.P.I. wind load and horizontal top load.

Cable "B" was fastened to one leg of the derrick at the finger-board girt. When the pull on this cable was 5540 lb. the torsional loading and a calculated horizontal loading at this point was 3920 pounds. This is equivalent to a portion of the drill pipe set-back and wind load combined.

Also fastened to the finger-board girt was cable "C," which produced a diagonal pull of 3340 pounds. This was resolved into two horizontal components at right angles, one of 1970 lb. and the other of 1300 lb., the resultant horizontal diagonal being 2360 pounds. This loading provided the required remainder of the drill pipe set-back and wind load combined.

The actual movement of members under stress was measured by means of two transits placed at right angles to each other and focused on scales attached to the top of the derrick and to the fourble-board girt. The movement in inches at the points indicated on the drawing is given in Table 1. Increased loadings amounting to 150 percent of the A.P.I. specifications were applied on all three cables and a final pull of 200 percent on cable "B," in order to apply a large torsional load, which gave an actual cable pull of 11,080 pounds. All loads and movements under load are given in the table.

The higher derricks such as the 136-ft. now commonly used and the 178-ft. for drilling deep fields like Rio Bravo and Wasco can be provided with high windows. Whether higher windows may also be desired is problematical, because of the limit to the length of casing that can be handled without hazard of injury due to bending.

Study of Characteristics of Commercial Gasolines

STUDIES of the various characteristics of commercial gasolines are being conducted at the University of Minnesota as a WPA project, according to a report from the Minnesota State WPA office to Washington headquarters of the Works Progress Administration.

Under the supervision of Dr. B. J. Robertson, associate professor in the Department of Mechanical Engineering, workers in the experimental laboratory are running a series of tests on gasoline samples purchased from commercial outlets in the Twin Cities area. Their aim is to determine if manufacturers are preparing products that will meet the rigid tests of the American Society for Testing Materials.

Results of the study will be evaluated according to methods approved by the U. S. Bureau of Standards and will be published. According to Dr. Robertson, this information should stimulate marketing of proper fuels, aid in determining the probable cause of motor trouble, and inform the public as to the quality of gasoline to be obtained at various market prices.

The samples are subjected to several tests, including the lead test, gum test, Reid vapor pressure test, corrosion test, and distillation test. Samples are purchased every six weeks and include high, low, and regular types of each trade brand. Through distillation tests it is hoped to determine how well the manufacturers follow the weather conditions in blending gasoline for use in Minnesota.

WPA workers already have completed a similar investigation of motor oils. They found that approximately one-third of all oils costing less than 30 cents a quart failed to meet the broad viscosity requirements of the Society of Automotive Engineers.

List of North American Mineral Laboratories

AS all the technical bureaus of the Federal Government are asked for lists of professional laboratories that make tests on raw and finished materials, the U. S. Bureau of Mines has revised its Information Circular 6999 entitled "Laboratories That Make Fire Assays, Analyses, and Tests on Ores, Minerals, and Other Inorganic Substances." This revision, prepared by the metallurgical division, is designated Information Circular 6999R and is issued in a limited edition available free to those who are especially interested.

In addition to listing private laboratories, this report explains briefly the work that certain bureaus of the Federal Government do in this field; also what is done in Alaska, the Philippine Islands, Canada, and Mexico. The circular deals with four areas—Eastern, Southern, Central,, and Western, including the Canadian Provinces. The states are listed alphabetically, as are the towns and firms therein. Column heads tell exactly what work is performed by these firms.

Following the names of assayers and analysts is a table giving a range of charges for assays and analyses. Another section of the report lists the ore-testing firms and the approximate charges for such work.

Gasification of Crude Oil in Reservoir Sands[1]

Part 1

By

A. B. SHEINMAN, K. K. DUBROVAI, N. A. SOROKIN, M. M. CHARUIGIN, S. L. ZAKS, and K. E. ZINCHENKO

DIFFERENT methods that might be used to recover additional oil from sands that have been depleted of their recoverable oil by wells, and processes that might be used to gain oil from sands that cannot be exploited commercially by wells have been studied by engineers of the U.S.S.R. Of the processes that appeared to have the greatest chances of success, the thermal process and gasification of the crude oil in the sand seemed to offer the greatest commercial possibilities. Soviet engineers visualized an oil-bearing sand and its combustible contents and impervious cap rock as a large subterranean gas producer and theorized that if the oil in the sand could be ignited and its combustion maintained by injecting air or hot gases into the sand through wells selected for the purpose, the underground producer process would be realized. Theoretically, they agreed, not only would the oil be vaporized and the reservoir pressure increased by the heat developed by the burning oil about the ignition well, augmented if necessary by the injection of hot gases rich in oxygen, but also the vapors and gases formed and drawn from the sand through producing wells could be condensed and separated from the noncondensible gas in special equipment at the wellhead.

The possibilities of recovering by thermal means large quantities of oil that could not be recovered otherwise except possibly by mining seemed so promising that a series of experiments was conducted at the Grozny Petroleum Research Institute in 1933 and 1935, to test the practicability of thermal processes for recovering oil from sands. The experiments were designed to test, under laboratory conditions and in models of petroleum structures, all phases of the thermal and subterranean gasification of petroleum in reservoir sands[2].

The experiments confirmed the original thoughts of the investigators and showed that at least in laboratory experiments oil can be recovered from "exhausted" oil sand by heat generated within the sand body. Specifically the experiments established the following facts:

1. Combustion can be maintained in sands by injecting air into them through wells, and high temperatures can be generated by the combustion.
2. The zone of combustion can be controlled and made to advance from the ignition well to sur-

[1]Translated from the Russian Oil Journal *Neftyanoe Khozyaistvo* 28, No. 4, April, 1935, by A. A. Boehtlingk, publisher of Foreign Petroleum Technology, Berkeley, California.

[2]The experiments are described in a report, "Podzemnaya gazifikatziya neftenuikh plastov i termicheskii sposob dobuichi nefti" (Subterranean gasification of petroleum strata and the thermal method of producing crude oil). Gorno-Geologicheskoe Neftyanoe Izdatel'stvo, 1935, Moscow.

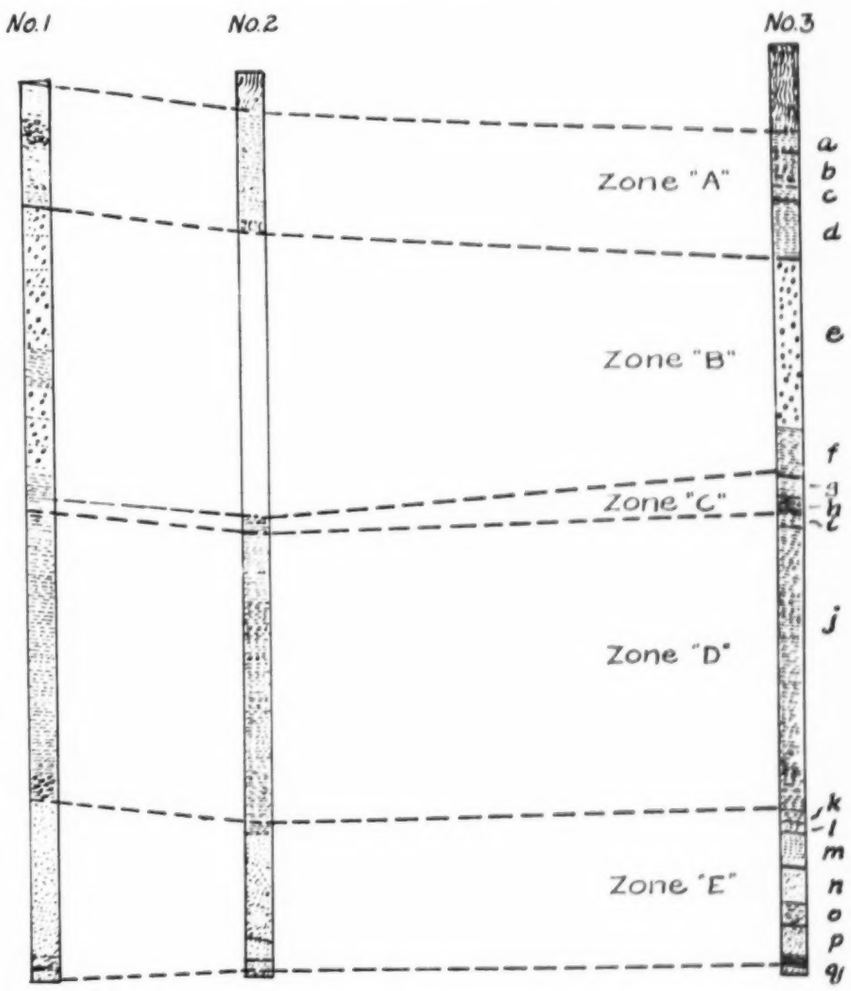


Fig. 1. Section through experimental bore holes showing clay, *m;* oil sand, *n;* clayey sand, *o;* oil sand, *p,* and clay, *q*

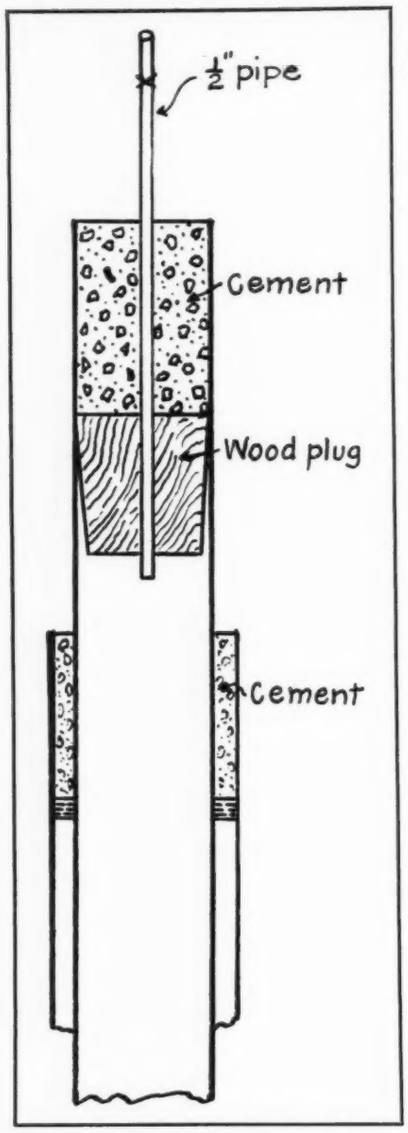


Fig. 2. Method of capping abandoned wells

rounding producing wells or it can be restricted to the bottom of the ignition well by feeding fuel into the well from the surface of the ground.

3. Charcoal can be used to start the combustion.
4. The sand stratum subjected to the thermal process releases all its crude oil, leaving the sand completely "dry".

Soviet engineers appreciated, however, that the success attained in the laboratory even in large-scale apparatus might not be duplicated in actual underground oil sands. For that reason they thought it desirable to transfer experimentation from the laboratory to the field and to continue the experiments along lines suggested by the information acquired in the laboratory. This report summarizes the experiments performed in shallow pits in the Shirvanui field of the Maineft and those subsequently performed in an oil zone in the same field that had been depleted of its recoverable oil by pumping and the application of vacuum.

Testing the Thermal Process in Shallow Pits

The pits to which the experimental work was transferred were shallow excavations along the outcrop of sands that were oil-bearing farther down the structure. Four holes 16½ to 19½ ft. deep were drilled into the shallow sand body. The holes were situated at the corners of a 16½-ft. square. When air was admitted under low pressure through one of the bore holes it traveled quickly through the sand to the other bore holes, proving that air for maintaining combustion in the thermal process could be forced into the sand and that the permeability of the sand body was such that the process could be carried on in the sand between the bore holes.

As the sands in the pits where the experiments were conducted contained water and no oil, crude oil was admitted to the ignition (combustion) bore hole before the tests were begun. When the oil was ignited and combustion maintained by injecting air into the bore hole the sand body became virtually a steam boiler. Water vapor escaped from the other bore holes and through cracks and fissures in the upper part of the sand stratum. Air bubbles could be observed wherever pools of water stood on the surface of the ground in the pits. In some places peculiar mounds formed on the surface of the ground and from some of the openings water and mud were discharged. As the thermal process progressed underground, the volume of gas and vapor escaping from the sand increased and the site "resembled a battlefield after a gas attack". While air was being admitted to the sand through the ignition bore hole the pressure in the sand increased to 60 lb. per sq. in., which was sufficient to raise the entire surface of the ground over a diameter of 20 to 23 ft. around the experimental bore holes. The experiments showed strikingly that cap rocks that are not impervious to gases and liquids, and uncapped or thief bore holes such as improperly abandoned wells, easily could interfere with the success of the process. Consequently, one of the most important requirements for the success of the process is that the oil zone must underlie an impervious stratum and that all abandoned wells in the vicinity of the project must be sealed against the escape of air or gas from the reservoir.

Experimentation Transferred to Deeper Sands

In order to continue the experiments on a more nearly commercial basis, one of the southern parcels of the Shirvanui field of the Maineft was selected as suitable for carrying out deeper-seated experimentation. For many years this area had been a prolific producer of oil; the sands originally had been highly saturated with oil and, owing to the large formation gas factor, oil recovery had been exceedingly efficient. Producing operations in the area had been discontinued seven years prior to the start

TABLE I
Oil and water content of samples of sand from zone "E"

No. of bore hole	Sampling point, ft. below surface of the ground	Percent crude oil by weight	Percent water by weight	Porosity, percent	Crude oil per cu. yd. of sand, gal.
1	257.2	8.53	2.28		
	262.5	6.08	0.65		
	264.1	4.39	0.89		
	318.2	8.92	0.16		
3	277.2	2.38	7.66	40.0	9.8
	281.2	3.57	1.80	44.4	13.1
	284.0	5.45	6.10		
	286.4	4.64	1.92		
	292.0	3.34	5.05		
	295.3	4.85	0.99		
	298.2	3.25	4.35		
	300.2	1.73	2.55		
	301.8	1.73	0.38		
	306.8	....	0.58		
	310.7	2.17	0.65		
	314.0	....	0.60		

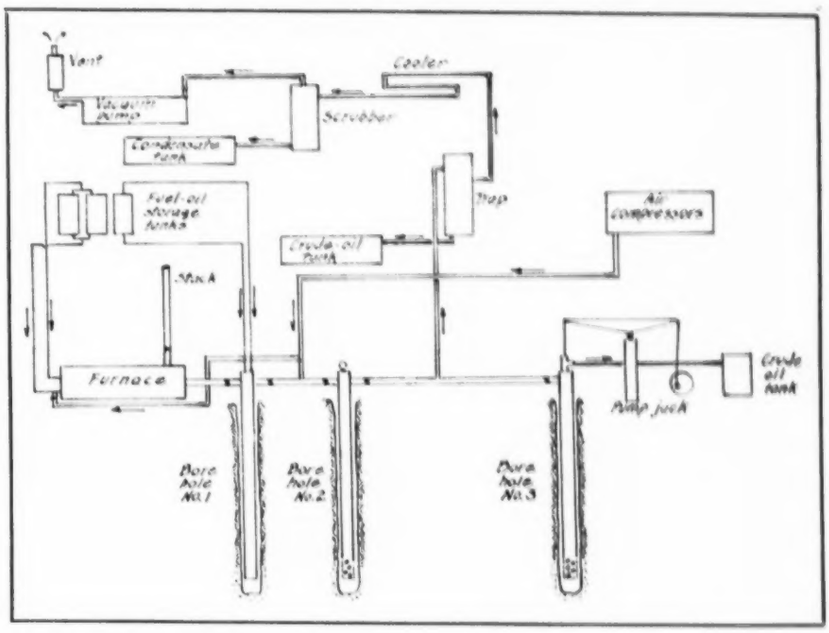


Fig. 3. Arrangement of surface equipment

of thermal experiments, and oil-producing activities had been concentrated in another part of the Shirvanui field four miles distant. Vacuum had been applied to the wells for some time before they were abandoned so that in every sense of the word the sands in the area selected for thermal experiments could be considered as having been depleted of oil recoverable by pumping.

The extent of the selected area was 9.88 acres and, according to drilling records, 124 to 143 wells had been drilled originally on this small area. The wells were spaced 16 to 20 ft. apart and it is believed that in no other oil field have wells been drilled so closely. Of the several oil zones in the Maikop series in the Shirvanui field, oil zone "E" (Fig. 1) was selected as most nearly satisfying the experimental requirements.

As none of the existing wells was considered suitable for carrying out the experiments, and any attempt to have used any of the old wells for the purpose of the experiment would have clouded the results, owing to the uncertainty regarding the condition of the casings, three experimental bore holes were drilled into zone "E". The experimental bore holes were arranged in a straight line; the distance between bore holes 1 and 2 was 19.7 ft. and 49.2 ft. separated bore holes 2 and 3. The oil-bearing sands of zone "E" were encountered at a depth of 256.23 ft. in bore hole 1; at 266.40 ft. in bore hole 2, and at 270.67 ft. in bore hole 3. The thickness of the oil zone in bore hole 1 was 63.98 ft.; 54.30 ft. in bore hole 2, and 58.07 ft. in bore hole 3. The total depth of bore hole 1 was 320.87 ft.; bore hole 2 was 323.16 ft. deep, and bore hole 3 was drilled to a depth of 332.35 ft. below the surface of the ground.

The experimental bore holes were drilled by hand with great care and without the introduction of oil or water during drilling. Although drilling to such depths by hand was slow and laborious, nevertheless, it assured the collecting of complete and accurate data on the physical characteristics of the formations penetrated. Formation samples were taken after each 1.6 ft. of drilling. The samples of the sands in zone "E" in bore holes 1 and 3 were analyzed for their content of crude oil and water. Table 1 gives the percent by weight of crude oil and water found in the samples. The porosity of the sand and the gal. of crude oil per cu. yard of sand for two of the samples also are given in Table 1. The fact that only 9.8 and 13.1 gal. of oil per cu. yard of sand were found remaining in two of the samples, or respectively 375 and 500 bbl. of oil per acre-foot of sand, shows the degree to which the sands had been depleted of their recoverable oil by ordinary methods of production. Individual samples of freshly drilled sands from the bore holes had a strong odor of gasoline and the oil in them ignited readily when lighted by a match. Only the most highly saturated samples, however, left traces of crude oil on paper.

The experiments in the Shirvanui

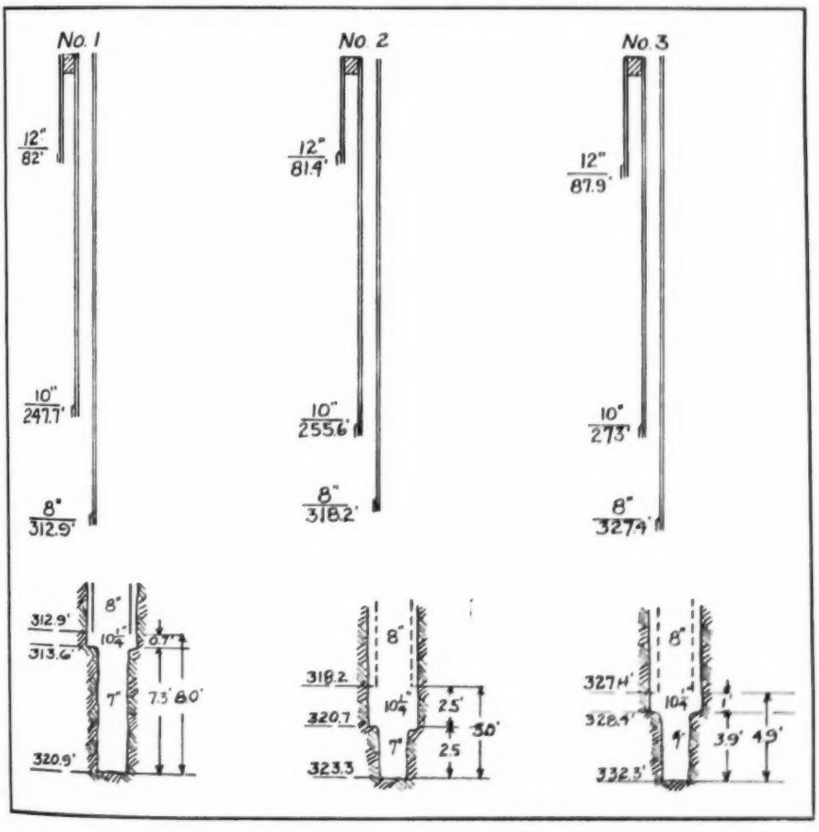


Fig. 4. Method of completing experimental bore holes

pits had demonstrated the adverse effect that improperly plugged wells might have on the success of the thermal process for recovering oil from sands. As most of the abandoned wells in the area selected for the deep-seated experiments had been carelessly and improperly plugged and undoubtedly would have permitted vapors and air to escape from the reservoir, all wells were capped and cemented in the manner shown in Fig. 2. Plugging with cement, however, failed to make all the wells gas-tight as the casing in some of the wells was in bad condition.

The surface equipment (Fig. 3) for the experimental work consisted of a compressor plant, vacuum plant, scrubbers, cooler, trap or oil-gas separator, furnace, and several oil and condensate tanks. The compressor plant contained three compressors, each having a rated capacity of 175 cu. ft. of air per minute under a pressure of 105 lb. per sq. inch. Each compressor was driven by a 55-hp. Diesel engine. The vacuum plant was equipped with two steam-driven piston-type vacuum pumps each having a capacity of 85 cu. ft. per minute.

The three experimental bore holes were lined with 12-, 10-, and 8-in. casing as shown in Fig. 4. Only bore holes 2 and 3, however, had perforated casing opposite oil zone "E". No perforated pipe was run into bore hole 1 as it was desired to concentrate the flow of air into the oil zone over a small area to assure local and intensive combustion of the oil in the sand near the bottom of the bore hole. The 8-in. casing in bore hole 1 terminated 8 ft. above the bottom of the hole and that in bore holes 2 and 3 terminated 5 ft. above the bottom. The casingheads were equipped with quick-closing valves and bore holes 2 and 3 were equipped with 2-in. tubing. The side outlets through which the gases from the sand were drawn were 4-inch. Air was conducted to the ignition well through a 2-in. line. Fig. 5 is a sketch of the head fittings of the bore holes 2 and 3; Fig. 6 shows the fittings on the ignition bore hole.

Compressed air was injected into bore hole 1 to determine the permeability characteristics of the oil zone. The passage of air from bore hole 1 to bore hole 2 was established after one and one-half to two minutes under an intake pressure of 22 lb. per sq. inch. While air was being injected into bore hole 1, the pressure in bore hole 3 increased to 0.3 lb. per sq. in. in three and one-half hours. The rapidity of the passage of air through the sands was regarded as satisfactory proof that the permeability of the sands was sufficiently great to permit maintaining combustion in the oil zone. The effect of air injected into the sands was noted by the change in the composition of the gas coming from bore hole 2. The previously constant content of 27 to 28 percent CO_2 in the gas from bore hole 2 became noticeably lower after 30 minutes of air injection and the O_2 content of the gas increased from 0.3 to 2 percent in two hours. Table 2 shows the composition of the gas from bore hole 2 before injecting air into the sands through bore hole 1 and the changes in composition occurring during the time air was injected into the reservoir.

EDITOR'S NOTE: Part 2 of this article will be published in the January, 1939, issue of *The Petroleum Engineer*.

Fig. 5. Wellhead fittings on bore holes 2 and 3

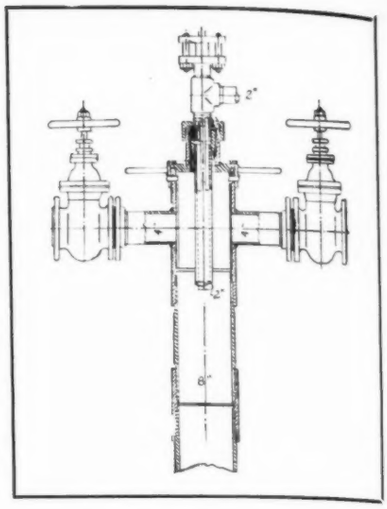


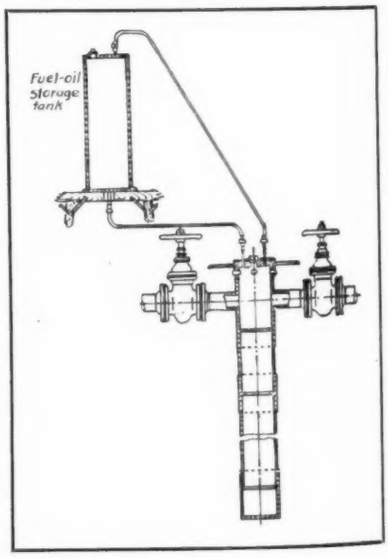
TABLE 2

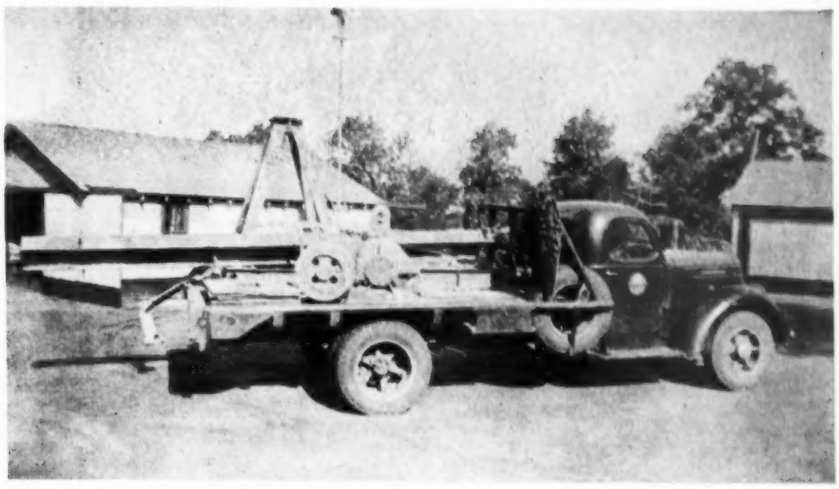
Composition of the gas from bore hole 2, before and during the time air was being injected into zone "E" through bore hole 1.

Sample no.	Time after first observation, hr.—min.	Composition of gas*			Remarks
		CO_2 percent	O_2 percent	CO percent	
1	.....	27.2	0.4	....	Samples 1 to 5 were taken
2	0–11	27.0	0.4	0.2	before air was injected
3	0–25	26.6	0.5	0.1	into the sand.
4	0–27	27.3	0.3	....	
5	1–45	27.4	0.4	....	
6	1–46	....	....	....	Beginning of air injection
7	1–56	27.4	0.4	....	into bore hole 1.
8	2–03	29.0	0.4	....	
9	2–07	27.8	0.1	....	
10	2–17	27.2	0.5	....	
11	2–25	26.8	0.6	....	
12	2–36	26.2	0.8	....	
13	2–50	22.1	1.2	....	
14	3–10	23.2	1.3	....	
15	3–20	18.7	1.3	....	
16	3–31	15.1	1.4	....	
17	3–41	15.1	1.9	....	
18	3–51	15.1	2.1	....	
19	4–00	14.4	2.0	....	
20	4–15	28.2	0.6	....	Injection of air stopped.
21	4–28	28.4	0.6	....	

*Orsat determinations.

Fig. 6. Wellhead fittings on the ignition bore hole





After being recovered from the river the pumping unit was loaded onto a truck for transportation to the company's warehouse

Pumping Unit Recovered From South Canadian River

Equipment required little more than cleaning and oiling to restore to working condition after 16 months in mud and sand

By C. C. SHREVE

Superintendent, Sunray Oil Company, Allen, Oklahoma

DURING the spring and summer of 1937 the Sunray Oil Company completely modernized three of its leases in the Allen Pool, Seminole County, Oklahoma. This modernization program was described in an article entitled "Efficiency Increased by Modernization of Surface Pumping Equipment" published in the January, 1938, issue of *The Petroleum Engineer*.

In June, 1937, while the modernization program was under way, the South Canadian River rose in one of its "wall-of-water" floods and undermined the legs of the derrick on Cully "B" 8 where the first of the new individual pumping units had just been placed in service. Some of the equipment disappeared in the quicksand but the structural-steel pumping unit floated down the river on a raft formed by part of the derrick floor and the large 10-in. by 10-in. sills bolted through the floor to the base of the unit.

Representatives of the Sunray Oil Company watched the unit ride the crest of the flood for nearly a mile and a half, until it finally drifted near the north bank, where the force of the water and the over-balancing effect of the heavy counterweights caused the raft to upset, the unit disappearing entirely below the surface.

When the water receded, the only part of the pumping unit visible was the front end of the beam plainly marked with the manufacturer's name plate protruding above the sand. The unit remained in this position for approximately sixteen months. As the large 10-in. by 10-in. sills, the counterweights, and the structural frame of the unit were firmly imbedded in the sand, recovery seemed impossible. Deep water immediately east and south of the unit and steep banks and impassable woods to the north and west added to the difficulties of recovery. Efforts to reach the unit by truck or tractor were of no avail.

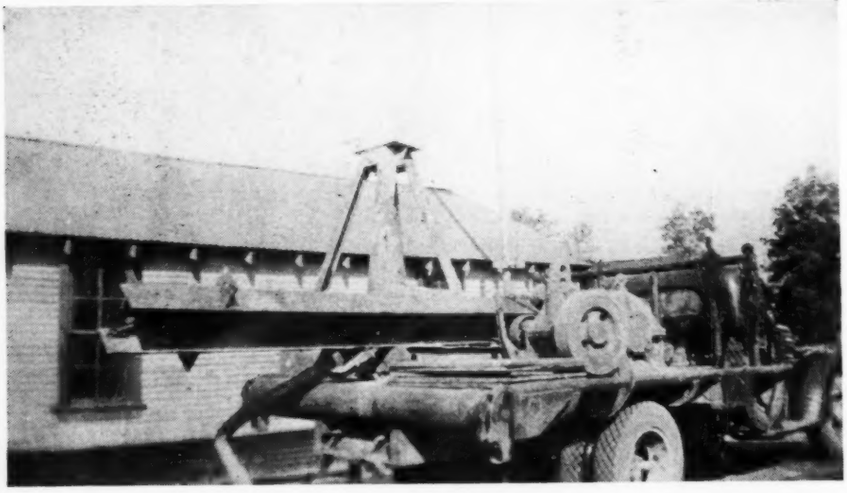
In June, 1938, the river again rose above flood stage. When the waters receded it was found that the channel had shifted, leaving a quarter-mile expanse of treacherous quicksand and silt between the unit and the water. The pumping unit was found to be imbedded even more deeply than before.

Two months later another flood came and when the river fell the water in the main channel was actually washing against the pumping unit, which was now imbedded in a steep bank of sand. It was held in place by the long 10-in. by 10-in. sills, which were buried deep in the sand.

In October, after surveying the position of the unit and making careful plans for salvaging it, the writer began the work assisted by a crew of men equipped with a skid-type sucker rod pulling winch mounted on a light truck, and two mule teams and wagons. The unit was approached from the southeastern, or opposite, side of the channel. It was necessary to take the equipment across a wide stretch of the sandy river bed. The teams were used because of the quicksand. Every time the truck broke through the surface and started to settle, the teams were hooked-on to get it moving again. Because of the treacherous nature of the river bed heavy objects must be kept moving; otherwise, they soon disappear in the quicksand.

The wagons were loaded with 3-in. by 12-in. by 20-ft. boards, which were used for the construction of a platform immediately across the channel from the imbedded pumping unit. The truck was anchored by cables to a deadman made of 6-in. pipe.

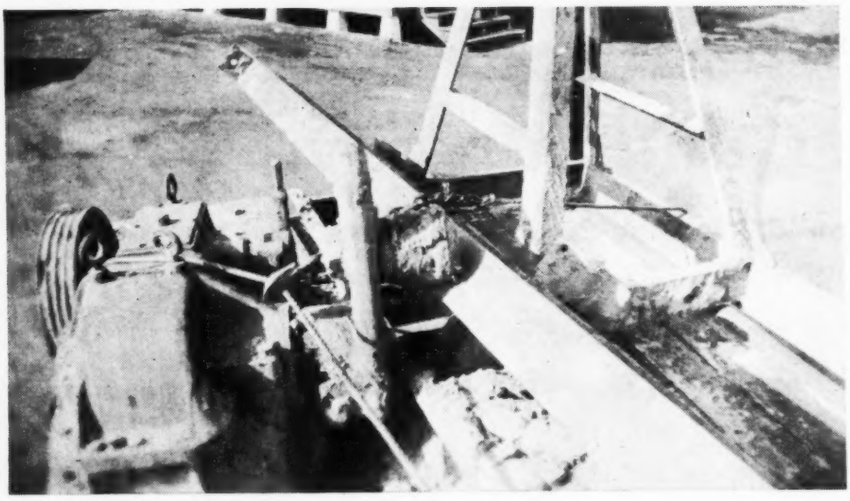
In order to hitch the winch line to the unit the men had to swim the river



Upon arrival at the warehouse and before being unloaded from the truck

carrying a long rope. After they reached the northwest bank they used the rope to pull the winch line across. The unit was then pulled from the bank and through the water. At the deepest part of the channel the unit was completely submerged; it was eventually pulled into shallow water near the truck. A high sand bank made it necessary to dismantle the unit. It was for this purpose that the platform of 3-in. by 12-in. by 20-ft. lumber was constructed. The various parts of the unit were placed on the truck and hauled to the shop at the Sunray Oil Company's Allen Camp, overhauled, and placed in working order for service at a new location.

Remarkable to state, the unit was found to have suffered very little damage, considering that it was imbedded in silt in an upside down position for 16 months. No parts in the double-reduction geared speed reducer had to be replaced. Cleaning and polishing the working parts was all that was required to put this speed reducer in good order for field service.



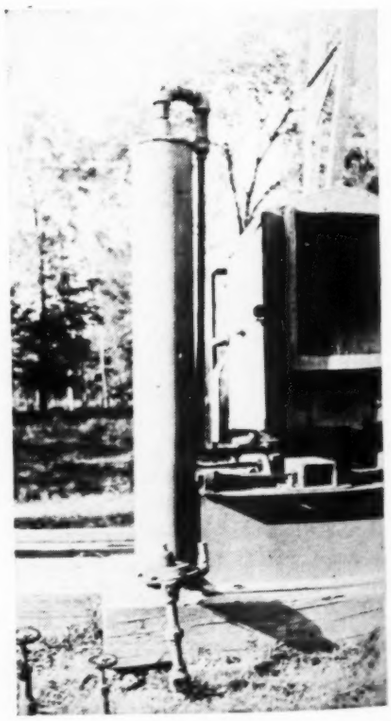
Before being cleaned. Mud and sand can be seen still clinging to the unit

Use of Vertical Expansion Tank Improves Engine Operation

ONE producer in the East Texas field sets the expansion tank in the gas line to the pumping engine vertically instead of horizontally. The gas enters the chamber at a point near the bottom and leaves at the top, passing to the mixing valve.

This position of the tank permits thorough settling of any liquid that may be carried by the gas, there being 48 in. of settling space instead of a maximum of eight as in the horizontal unit. Furthermore, the flow of gas is directed away from, instead of over, the liquid that collects, so there is no danger of the fluid being picked up by the gas flowing to the engine. No slugs are drawn into the mixing valve to cause irregular operation or stoppage of the power unit.

A drain at the bottom of the tank permits removal of the liquids collected. The switcher drains the tank at regular intervals before starting the engine. A check on liquid level may be obtained by opening the inlet valve. The gas enters the empty chamber with a hissing noise but if the liquid level is above the opening a gurgling or bubbling noise is audible.



A vertical expansion tank serves as a separator and reduces the danger of liquid reaching the mixing valve and stopping the engine

Catalytic Agent An Important Factor in the Pyrolysis Process

The catalyst regulates the reaction of the oil particles in their molecular dissociation or recombination

By RAFAEL FUSSTEIG

CATALYSIS is one of the most varied and interesting phenomena for the reason that chemical reactions are initiated and their velocity affected by a substance, the catalyst, that introduces no energy, and undergoes no change while it remains in the region of chemical activity that it seemingly has induced. The theory and principles of catalysis are frequently applied in the petroleum industry, especially in pyrolytic processes, and there are several systems that employ catalysts of different types and composition in their operation.

Usually, these catalytic agents are added to the system to act upon the oil or rather to hasten the reaction of the oil particles in their molecular dissociation or recombination. The catalyst not only dissociates the constituents of the hydrocarbons, but it effects combination between the hydrogen thus freed and hydrocarbon radicals, thus forming a mixture of condensible hydrocarbons. In other words, the catalytic agents are added to regulate the combination of the split or introduced hydrogen with the hydrocarbon radical. The hydrogenation power of a catalyst should not be too strong, because if it is, instead of the polymerization reaction between the $=CH_2$ radicals combination of these active radicals with methane molecules will occur to a great extent. This does not mean that the activity of the catalyst should be reduced, because the reaction then would require increase of temperature, resulting in the formation of methane.

To obtain a catalyst with a limited hydrogenation power and a high rate of activity, a substance having a large surface must be created. This can be done by calcining metal salts. For example, calcining cobalt and nickel nitrates produces a catalyst having a large contact surface. A much more active catalyst can be obtained by precipitating nitrates by alkali carbonate. Moreover, the activity and durability of a catalytic agent can be increased by precipitating the components in the presence of a medium of indifferent distribution; diatomaceous earth has been found to be the best material for this purpose. In the opinion of Fischer, the best gasoline catalyst is a voluminous catalyst obtained by precipitating nickel or cobalt with alkali carbonate in the presence of diatomaceous earth. These voluminous catalysts, however, possess the disadvantage of a proportionately small quantity of nickel or cobalt requiring a great contact space. For example, eight grams of nickel or cobalt distributed in the diatomaceous earth requires a volume of 50 cubic centimeters. According to thermodynamic calculations, this disadvantage may be offset by allowing the gas to flow through the catalyst at higher velocity. Practically, it has been stated that the greater the velocity the smaller the formation of liquid hydrocarbons. The catalysts distributed in diatomaceous earths possess a low heat conductivity; therefore, the increasing throughput of the gas is unable to dissipate quickly the evolved heat of reaction. This causes local overheating, resulting in the formation of methane. It is obvious from the above that the medium in which the catalyst is distributed must occupy a considerably smaller contact space.

Of course, such a catalyst should possess the same activity as the above-mentioned voluminous catalyst, and should be able to dissipate the heat of reaction from the contact chamber. Recently it has been found that the grinding of the catalyst also influences the above-mentioned characteristics. Fischer precipitated a mixture of nickel, aluminum, and manganese in diatomaceous earth, grinding it afterwards in an iron mill for 12 hours. After this grinding the catalyst occupied a third of its original volume; in spite of the diminution in volume, the activity of the catalyst remained the same, even when the catalyst was distributed in a layer ten cm. thick. It can be seen that grinding of the catalyst to reduce the volume does not result in a decrease of its activity. Even the ground catalyst precipitated in diatomaceous earth, however, is unable to discharge quickly the evolved heat of reaction because of the low heat conductivity of the earth. It is apparent that a different distribution medium should be employed, which would have better heat conductivity. Raney[1] was the first to find a highly active nickel catalyst suitable for the solidification of fats. The method of preparation consists in the melting of nickel with a certain proportion of aluminum or silicon, and then eliminating this aluminum or silicon from the alloy. This procedure results in the formation of a metal skeleton having a large surface of activity. The removal of aluminum or silicon can be accomplished by treating the alloy with a solution of sodium carbonate or with small amounts of sodium hydroxide. Of course, the nickel should not be attacked in this operation. Treatment with steam under high pressure also improves the properties of the catalyst. The above-mentioned procedure of Raney gave a quite new type of catalyst having a developed surface of activity, and caused the petroleum technologists to study the possibility of using such catalyst skeletons in the petroleum industry, particularly in the catalytic polymerization processes.

Such a catalyst possesses many advantages. The metallic form of skeleton makes superfluous the reduction of the catalyst at high temperatures. Furthermore, the metallic form of catalyst possesses high heat conductivity, resulting in rapid discharge of the heat of reaction. In addition to this, the metallic catalyst occupies a considerably smaller volume than that of the precipitated kieselgur catalysts.

The "Kaiser Wilhelm Institut fuer Eisenforschung" in Dusseldorf has prepared nickel skeleton catalysts in the following manner: equal quantities of pure nickel and aluminum have been melted under high vacuum in a chamotte crucible. Because the melting of the nickel and aluminum causes a considerable evolution of heat, because

[1] U.S.P. 1,563,587.

mixed crystals are formed, the nickel must be added in small amounts (about ten portions) to the molten mass of aluminum. The cooled melt is then ground, and the aluminum is extracted by sodium hydroxide. For example, 50 grams of the ground alloy is added to 250 grams of the dilute sodium hydroxide (50 grams of NaOH and 200 grams of water), which is cooled by ice. This operation requires about two hours, in which the main reaction is completed. After this reaction the mixture is heated on a water bath for about two hours, then 100 grams of the dilute sodium hydroxide is added, and the mixture heated on the water bath until no evolution of hydrogen is observed. The clear solution of sodium aluminate is then decanted, and the nickel is washed seven times with hot water.

After this operation the nickel particles are filtered and washed with distilled water until the filtrate shows a neutral reaction. Then, the filtrate is washed three times with ethyl alcohol. The catalyst is then ready for use, but when the catalyst is to be stored it must be submerged in ethyl alcohol, because under the influence of the air the activity of such a catalyst skeleton gradually decreases. The reason for this is that such catalysts have pyrophorous characteristics. For the same reason the washing must be performed in such a manner that the catalyst remains moist.

The melting of catalytic metals with silicon is a simpler process than the melting of the same metals with aluminum. The reason for this is that melting with silicon causes no spattering of the melted mass; however, removal of silicon from the alloy by means of sodium hydroxide is considerably slower than the extraction of aluminum from the alloy with the same agent. Therefore, the extraction of silicon from the alloy requires in some instances two to three days. Of course, the time required for removal of silicon from the alloy depends largely upon the size of the alloy grains, and upon the content of silicon. All proportions of these metals can be mixed and melted for the production of skeleton catalysts. These skeletons, however, have other very important advantages: they do not require an exact washing, as indicated in the extraction of aluminum from the alloy, and it is quite superfluous to keep this type of catalyst under ethyl alcohol. An ordinary washing with water is quite sufficient. Of course, the activity of a catalyst skeleton of the same metal differs when made from different alloys. Because of this phenomenon, the skeleton from the alloy of, for example, nickel and aluminum, has quite different activity characteristics from that of the alloy of nickel and silicon.

But not only does the sort of alloy used in making the skeleton influence the results of pyrolysis processes; for example, when using cobalt instead of nickel, quite different results are obtained in the pyrolysis. Cobalt is considerably stronger in its activity than is nickel. In other words, cobalt produces twice as much olefins as does nickel. The amount of hydrogen in the dissociated gas also plays a very important part in the formation of hydrocarbons. The early theories of the catalysis process maintained that the surface of a catalyst is able to transform the hydrogen in the active hydrogen atoms. Other theories explained this phenomena in the reduction and oxidation of hydrocarbons by means of the active surface of the catalyst; but these theories could not explain the reason that the same catalysts show quite different powers when produced by different methods. The modern theories concerning the structure of atoms give us a better explanation of this matter. According to these theories, the surface of all crystalline substances may be considered unsaturated matter, capable of adsorbing molecules of other matter by means of their rays of force. The adsorbed molecules are submitted to a deformation, thus forming a new field of force opposite the neighboring gas space. In other words, the deformed molecules become more active.

According to this theory, we may explain the activation of the hydrogen by the aid of a catalyst; the catalyst is able to split the hydrogen atom into the electron and nucleus. The electrons are able to penetrate into the light movable electrons of the catalyst, whereas the nuclei adhere to the surface of the catalyst, and are able to react with the split hydrocarbon radicals. In the opinion of the writer, the carbon atoms are submitted to the same action, this action being able to transform the carbon with four linkages into the carbon with two linkages[2]. Thus, these characteristics decide whether saturated or unsaturated aromatic hydrocarbons are formed. Of course, these properties depend upon the type of metal and upon the method of its activation.

As mentioned, the precipitated catalyst has quite different properties than the skeleton catalyst. This consideration leads us to the conclusion that the quantity and the quality of the artificially-formed light movable electrons in the catalyst play the most important role in the catalysis. In other words, the thicker the layer of the light movable electrons, and the more active the electrons, the greater the activity of a catalyst.

Before discussing the application of the above-mentioned types of catalyst, it may be well to point out some of the investigations performed by the writer. The first experiment was performed using a precipitated catalyst. For this purpose certain quantities of nickel were dissolved in nitric acid. To dissolve 25 grams of nickel, about 27 grams of nitric acid are theoretically necessary. The dissolved nitrate was then calcined at a red heat, and the oxide formed was reduced at a temperature of 300 to 325 deg. cent., until water was no longer evolved; however, this catalyst showed a very unpleasant inconvenience; when exposed for 24 hours to the atmosphere, it lost entirely its activity, taking up moisture from the air. Therefore, such a catalyst must be kept from contact with the air.

With the aid of this catalyst the pyrolysis of a cracking gas was performed at atmospheric pressure. The experiment was carried out at a temperature between 250 and 450 deg. centigrade. The polymerization of the unsaturated compounds began at a temperature of 330 deg. cent., and a yield of 25 cc. per cubic meter was noted. With the increase of the temperature the yield of the liquid compounds increased, and at a temperature of 450 deg. cent., the formation of the liquid hydrocarbons increased to 50 cc. per cubic meter of gas.

In order to increase its activity, the writer mixed the precipitated nickel with diatomaceous earth; however, no increase in activity could be observed in further experiments. This earth even caused some trouble on account of the necessity for temperature increase. To learn the influence of the size of the grain on the catalysis, the writer ground the calcined nickel before using it as a catalyst. For this purpose two sorts were made; a medium-sized grain and a finely-powdered substance. Experiments with the first showed a favorable effect, whereas pyrolysis with the aid of the finely-powdered catalyst even resulted in the deterioration of the catalyst. The reason for this is that the first sort contains on its surface a greater number of electrons than does the finely-powdered catalyst. Thus it is seen that there are a maximum and minimum of the efficiency of the catalyst, depending upon the size of the grain. Before using a catalyst, therefore, it is necessary to find the grain size that will give the greatest efficiency in the formation of gasoline-like anti-knock hydrocarbons.

[2] *The Petroleum Engineer*, 1937, No. 1.

Let us now discuss the characteristics of the gasoline obtained by the action of the precipitated catalyst. As known, the catalyst is employed to produce the necessary reactions. This consists of splitting the hydrocarbons into active carbon and hydrogen atoms, and formation of the $=CH_2$ radicals, and has been described in the writer's previous article[2]. The more $=CH_2$ radicals a catalyst produces the better the catalyst. If instead of these active radicals other radicals enter into reaction, it proves that the catalyst is unable to direct properly the reactions. The investigations of the writer with the precipitated catalyst showed that the process was directed toward the formation of gasoline-like liquid olefin hydrocarbons.

It has been noted that the activity of the catalyst gradually decreased and the formation of saturated hydrocarbons and coke increased. The catalysts obtained by precipitation do not have long life and strength; as a result of this deficiency the yield of gasoline decreases after a short time and the gasoline shows high knock characteristics. The reason for this seems to lie in the diminished activity of the electrons and nuclei. According to the hypothesis of the writer, this diminution is caused by traces of nickel nitrate that remain unattacked in the preparation of the catalyst even after the strongest reducing process.

These substances are distributed in the catalyst in such a manner that they disturb the electric field at many points on the surface of the catalyst, preventing splitting of the catalyst into electrons and nuclei. The writer has performed experiments with the same gas, operating under higher pressures, but they produced unfavorable results. Neither olefins nor aromatic hydrocarbons could be observed; only saturated hydrocarbons, unsaturated higher molecular hydrocarbons, and coke were obtained. To increase the activity of the catalysts, other methods have been tried. First, different alloys have been taken into consideration, such as nickel, cobalt, iron, and manganese with aluminum or silicon. The aluminum or silicon must be removed by chemical extraction from the alloy to get a skeleton of metal with a large surface.

The alloys of metals with aluminum: The alloy containing 60 percent nickel, and 40 percent aluminum has been studied. The alloy was pulverized in a mortar for a final powdering. Then an excess of sodium hydroxide was added, this mixture being then heated for eight hours on a water bath. This extraction process consists in the conversion of the aluminum to sodium aluminate, this aluminate being soluble in water. This mixture, after careful decantation, was washed with water until the nickel skeleton was free from traces of aluminate. This catalyst was used under the same conditions, and the same gas was used. The beginning of the chemical reactions took place at 320 deg. centigrade. The formation of the gasoline-like hydrocarbons reached the maximum at 420 deg. centigrade.

Under these conditions the process yielded 95 cc. per cubic meter of gas. This process showed that the nickel skeleton is able to produce more unsaturates and aromatics than the same precipitated metal. In other words, a greater amount of the $=CH_2$ radicals enter into reaction by means of the nickel skeleton, this reaction resulting in a larger yield of a gasoline containing more olefins and aromatics. In consequence, a smaller formation of higher molecular hydrocarbons and coke will be obtained. The analysis of this gasoline showed 15 percent olefins and 6 percent aromatic hydrocarbons. With the increase of the pressure the amount of olefins and aromatics gradually increased, and when the pressure reached eight atmospheres, the content of olefins and aromatics increased to 18 and 11 percent respectively.

Comparing the results of the nickel skeleton catalyst with that of the precipitated nickel, we reach the conclusion that the electrons and nuclei of the nickel skeleton are more active in directing the final reactions to the formation of olefinic and aromatic hydrocarbons. Let us now consider the question of what proportions of nickel and aluminum are necessary to obtain the maximum yield of liquid hydrocarbons. The writer also studied this problem, and observed that the maximum yield of liquid hydrocarbons can be obtained when using an alloy of 60 percent nickel and 40 percent aluminum. Increasing the content of aluminum in the melting mass to 50 percent did not change the efficiency of the nickel skeleton. Use of more than 50 percent aluminum in the melting mass decreases the activity. The more aluminum above 50 percent the less the activity. Table 1 shows these characteristics:

TABLE 1

Composition of the alloy	*cc. liquid per cubic meter gas*
10% Ni + 90% Al	
25% Ni + 75% Al	32.
40% Ni + 60% Al	85.
50% Ni + 50% Al	85.
60% Ni + 40% Al	63.
75% Ni + 25% Al	15.
80% Ni + 20% Al	4.
85% Ni + 15% Al	—

To increase the activity of the nickel skeleton, the writer has melted and added to the alloy of 40 percent aluminum and 60 percent nickel certain quantities of copper, cobalt, iron, and manganese; however, the addition of copper considerably reduced the activity of the nickel skeleton. The addition of cobalt lead to a certain improvement of activity. The addition of iron considerably increased the activity of the nickel skeleton. This phenomenon may be considered as very remarkable because the extraction of aluminum from an alloy of iron and aluminum forms an iron skeleton having quite inactive properties. The addition of 10 percent iron to the nickel catalyst increases the formation of liquid hydrocarbons from 85 cc. to 128 cc. per cubic meter of gas. The addition of manganese to the alloy of nickel and aluminum gives quite different characteristics. As known, the precipitated manganese shows a very high activity. Because of this manganese was added to the above-mentioned alloy but it even reduced the activity of the nickel skeleton. Here can be seen a very remarkable phenomenon; the addition of iron improves the activity of the nickel skeleton, although the iron skeleton in pure state is quite inactive, whereas a precipitated manganese skeleton shows a very high activity, but the nickel-manganese skeleton is less active than the pure nickel skeleton. The reason for this seems to lie in the contrasting powers of the nuclei and electrons of nickel and manganese, so that a decrease of activity occurs. In the opinion of the writer, the contact of certain metal skeletons causes an increase of the splitting into electrons and nuclei. Therefore, it is necessary to find metals that will cause a maximum splitting of the active nuclei. This is very important for all pyrolysis processes. Table 2 shows the characteristics of the alloy skeletons:

TABLE 2

Composition of the alloy	*cc. liquid hydrocarbons per cubic meter gas*
40% Ni + 50% Al + 10% Cu	18.
40% Ni + 50% Al + 10% Co	89.
40% Ni + 50% Al + 10% Fe	121.
40% Ni + 50% Al + 10% Mn	54.

It has been stated by the writer that the activity of the catalyst can be increased by impregnating a metal skeleton with a precipitated catalyst. The activity of this combination is greater than that of the components. This leads the writer to the conclusion that the electrical power of atoms of precipitated metal differs entirely from that of atoms of the same metal as a skeleton. When they are combined in the proper ratio, the optimum splitting into electrons and nuclei occurs.

As an example, a precipitated nickel gave 50 cc. of liquid hydrocarbons per cubic meter of gas, whereas pyrolysis of the same gas with the aid of a nickel skeleton yielded 95 cc. liquid hydrocarbons under the same conditions. If the nickel skeleton is impregnated with certain quantities of precipitated nickel the yield of liquid hydrocarbons will increase to 105 cc. per cubic meter of gas. Better results can be obtained by mixing three percent thorium nitrate to a nickel skeleton, and heating the mixture to redness. The catalyst thus obtained gives under the same conditions 130 cc. of liquid hydrocarbons per cubic meter of gas. It can be seen that the use of a proper mixture of metals may increase the formation of liquid hydrocarbons. Use of a good mixture not only increases the quantity of gasoline-like hydrocarbons produced but also causes formation of a larger quantity of olefinic and aromatic hydrocarbons.

A multitude of combined, unknown catalysts exist in many processes in nature. It must be admitted that all wonders that take place in nature occur with the aid of proper catalysts. Thus the assimilation of carbon dioxide from the air by plants to form different carbohydrates is a consequence of the action of certain chlorophyllic catalysts.

The writer has studied the dependence of the sort of liquid hydrocarbons obtained on the sort of catalyst used. These studies lead the writer to the conclusion that the more active the electrons and the nuclei of a catalyst the stronger was the reaction. Thus the catalysts for the formation of gasoline may be divided into three chief sorts:

1. Catalysts unable to keep labil the active $=CH_2$ radicals for a proportionately long time during the reaction processes. This results in the addition of hydrogen atoms, leading to the formation of paraffinic hydrocarbons. On the other hand, the addition of carbon atoms takes place during this process, leading to the formation of higher molecular hydrocarbons.

2. Catalysts able to keep the $=CH_2$ radicals in the free state somewhat longer, so that olefinic hydrocarbons are obtained. Of course, the yield of liquid hydrocarbons obtained depends largely upon the quantities of active nuclei and electrons. In other words, the greater the content of nuclei and electrons in the catalyst the longer time the $=CH_2$ radical can exist in the free state, and the more olefinic hydrocarbons are obtained.

3. Catalysts having not only the ability to keep the $=CH_2$ radicals in the free state for the time necessary to form olefinic hydrocarbons but having also nuclei and electrons so active that they are even able to transform the olefins into cyclic hydrocarbons.

Of course, these catalysts represent only ideal types because their preparation is practically impossible under the conditions known at present. It is possible, however, to prepare catalysts that are able to form a large proportion of the desired hydrocarbons in the liquid obtained; but before entering into this matter let us continue the discussion of the experiments with other catalytic metals.

In further experiments the alloy of cobalt and aluminum has been considered. Precipitated cobalt has been known for a long time as a good catalyst. It gives about 65 cc. of liquid hydrocarbons per cubic meter of gas, provided the above-mentioned conditions are used. Therefore, the writer has studied different proportions of the alloy of cobalt and aluminum. The first experiment was performed using an alloy of 40 percent cobalt and 60 percent aluminum; however, a skeleton obtained from this alloy has slight activity. Under the above-mentioned conditions only nine cc. of liquid hydrocarbons per cubic meter of gas could be obtained. Besides, this catalyst showed another very serious defect; after a very short time it became quite inactive. The writer experimented with other proportions of cobalt and aluminum but they led to unfavorable results.

The writer performed the pyrolysis using a cobalt skeleton impregnated with precipitated cobalt in the proportion 50 to 50. Also, in this process an increased yield of liquid hydrocarbons was produced. Under the same conditions, the yield increased to 90 cc. of liquid hydrocarbons per cubic meter of gas. Comparing the results obtained using the two types of cobalt to those obtained using a mixture, it must be stated that the latter presenting two sorts of nuclei and electrons shows greater activity. This phenomenon leads to the increased yield of liquid hydrocarbons.

When this mixture was impregnated with 10 percent precipitated thorium the yield increased to 108 cc. of liquid hydrocarbons per cubic meter of gas. The addition of 10 percent manganese to the mixture caused an increase of the yield to 115 cc. per cubic meter of gas. The writer has stated that the greater the yield of liquid hydrocarbons obtained with the aid of the catalyst the greater the amounts of olefinic and aromatic hydrocarbons that are formed during the process. (Table 3).

Of course, if the pressure is allowed to increase during the process, the yield of olefinic and aromatic hydrocarbons increases considerably.

The alloys of metals with silicon: Nickel and silicon were used for the first experiments in preparing metal skeletons from the alloys of metals with silicon. These two metals were melted in a chamotte crucible, then sodium hydroxide was added to the melted mass. This operation is a very necessary one because, as mentioned previously, the transformation of silicon into sodium silicate is difficult at room temperature. The addition of sodium hydroxide to the melting mass causes no frothing over as occurs during the melting of nickel and aluminum, and therefore the addition of the sodium hydroxide to the melting mass of nickel and silicon presents an economical and technical advantage.

To transform 50 grams of silicon into water-soluble sodium silicate, about 145 grams of sodium hydroxide must be added to a proper melting mass. The nickel skeleton thus prepared has greater durability than the nickel skeleton obtained from the alloy of nickel and aluminum; however, they differ entirely in their activity. Using the nickel skeleton obtained from the alloy of nickel and silicon under the same conditions, only 30 cc. of liquid hydrocarbons per cubic meter of gas could be obtained, these hydrocarbons containing neither olefins nor aromatic hydrocarbons. This nickel skeleton has been impregnated with the nickel skeleton of the alloy with aluminum, but the pyrolysis process using this mixture yielded no favorable results.

A small increase of activity has been observed when the nickel skeleton from the alloy of nickel and silicon was impregnated with precipitated nickel. The addition of thorium to the

TABLE 3

Composition of the alloy	*Olefins percent*	*Aromatics percent*
40% Ni + 50% Al + 10% Cu	0.	0.
40% Ni + 50% Al + 10% Co	6.	8.
40% Ni + 50% Al + 10% Fe	12.	21.
40% Ni + 50% Al + 10% Mn	5.	14.
50% precip. Ni + 50% Ni-skeleton	18.	38.
40% Co + 60% Al	0.	0.
45% Co + 45% Al + 10% Th	12.	35.
45% Co + 45% Al + 10% W	17.	38.
50% precip. Ni + 50% Co-skeleton	18.	42.
50% precip. Co + 50% Ni-skeleton	23.	48.

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"FIELD TESTED", in the Lufkin sense of the word, means close observation throughout the years . . . of thousands of Lufkin Units, and the correction of the slightest imperfection.

"FIELD TESTED" means more than the building of one or two units for trial purposes.

LUFKIN PUMPING UNITS

LUFKIN UNITS are manufactured in Lufkin, Texas, by the Lufkin Foundry & Machine Company. Branches in principal oil centers

nickel skeleton in the form of thorium nitrate, the mixture then being subjected to a reduction process, increased the activity. This mixture caused a yield of 55 cc. of liquid hydrocarbons per cubic meter of gas; however, comparing these results to those using the nickel skeleton from the alloy of nickel and aluminum, it must be admitted that the latter shows considerably greater activity.

On the contrary, the cobalt skeleton obtained from the alloy of cobalt and silicon gave better results than that of the alloy of cobalt and aluminum. Using the cobalt skeleton from the alloy of cobalt and silicon in the pyrolysis process under the same conditions, 75 cc. of liquid hydrocarbons per cubic meter of gas could be obtained. The writer has mixed the cobalt skeleton from the above-mentioned alloy with precipitated catalytic cobalt and obtained 95 cc. of liquid compounds. The impregnation of this mixture with thorium nitrate and reduction before the pyrolysis process, caused the pyrolysis to yield 115 cc. of liquid hydrocarbons. When this mixture was impregnated with a molybdenum salt, the yield of liquid hydrocarbons increased to 145 cc. of liquid hydrocarbons. Of course, the formation of olefinic and aromatic hydrocarbons will increase with increase of the formation of liquid compounds. In other words, the more liquid hydrocarbons are obtained by means of a catalyst the more olefinic and aromatic hydrocarbons of the gasoline type are present in the liquid.

Let us now consider the possibilities of further increase of the formation of gasoline-like hydrocarbons. The above-mentioned pyrolysis process has been carried out using eight grams of catalyst. In further experiments the writer used a greater quantity of the catalyst but the same velocity of the gas. When using 50 grams of catalyst, the yield increased three to five times. Thus, the nickel skeleton from the alloy of nickel and aluminum impregnated with precipitated iron gave a yield of 435 cc. of liquid hydrocarbons per cubic meter of gas. The mixture of cobalt skeletons from the alloys of cobalt and aluminum and of cobalt and silicon led to a yield of 506 cc. of liquid hydrocarbons per cubic meter of gas.

From the above experiments it appears that the proper use of the catalyst involves not only the selection of a proper metallic catalyst but also the choice of catalytic mixtures that will create such a motion of electrons and nuclei in the catalytic substance that the desired reaction results. The reaction process to form low molecular hydrocarbons requires quite different motions of electrons and nuclei than that to form higher molecular hydrocarbons. The formation of olefinic hydrocarbons requires quite different catalytic substances than are needed for formation of saturated compounds. In this article, the writer has given new data on the matter, which he hopes may lead to new economical and technical progress in all types of pyrolysis.

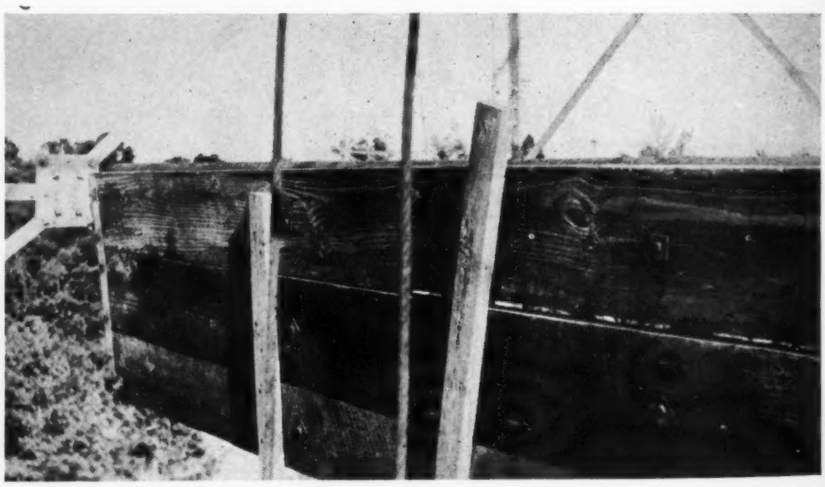
Hanging Board Platforms Vertically When Idle Increases Service Life

By CHARLES C. LYNDE

EXPOSED to wind, sun, and rainy weather, wooden platforms in derricks have only a short service life before becoming so badly rotted as to be a menace. Frequent renewal adds appreciably to the expense of well upkeep.

By expending a little more time and effort during the erection of the scaffold, one operator in the East Texas field has more than doubled the safe, useful life of his tubing board platforms by constructing them so they may be hung vertically, instead of lying flat, when not in use. Instead of the entire upper surface, only the edges of the timbers are thus exposed to the disintegrating effect of rain.

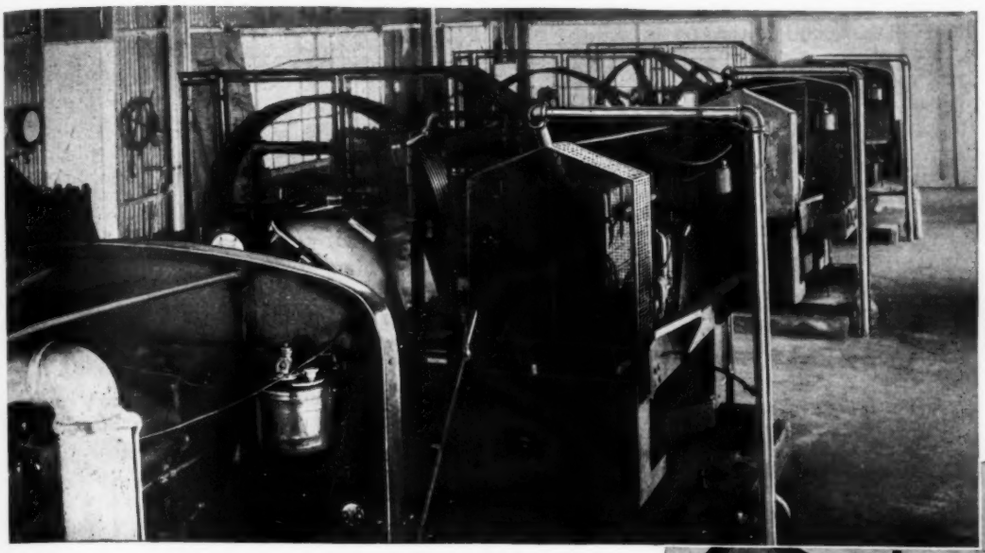
Along the outer edge of the platform is bolted a 3-in. or 4-in. pipe long enough to span the derrick opening at the height of the tubing board. The timbers are cut to the proper length to limit endwise movement of the platform and thus insure the hinge or swivelling pipe being retained within the derrick.



Tubing board is hinged and hangs vertically when idle, reducing weathering of materials, at the same time permitting maximum clearance inside the derrick

To permit the platform to hang in stand-by position, it is necessary only to unleash the back or derrick side of the board, to slide the board far enough toward the center of the derrick opening to permit the supporting cleats to hang clear, and then to pull the platform, now hanging vertically, against the derrick legs and lash it there to prevent swaying or pounding in high wind.

INTERNATIONAL Power Units Provide Unusual Economy in Booster Stations



Above are the four International 6-cylinder PA-100 Power Units that power the booster pumps in the station shown at the right. The Model PA-100 oil-field type power unit with radiator and hood is shown at the left. There are 11 models in the International Power Unit line, ranging up to 110 max. h.p. for gas, gasoline, and Diesel.

"These Internationals are the sweetest running engines I ever saw. They set out there and run day after day with scarcely any trouble. If anything goes wrong I can find it quickly and have them going in short order. And any time we order a part for an International we can get it and it will fit."

This is the report on the four International 6-cylinder PA-100 Power Units operating booster pumps in the station shown above. These engines, using natural gas, power four pumps 2½ x 5 x 10-inch in size. Total capacity is 22,000 barrels every 24 hours. They are pumping through an 8-inch line for four miles and then through a 10-inch line for over 70 miles. They can be cut in or out as power requirements vary.

At the time these pictures were taken, these International Power Units had operated 8,230 hours, 10,365 hours, 9,545 hours, and 8,360 hours, respectively. And the *upkeep cost during that time averaged only $130 per engine,* including new cylinders and pistons. These were recently installed and the Internationals were again ready for thousands of hours of operation.

Investigate International Power Units for your work. Find out how they save money powering drilling rigs, booster pumps, lift pumps, and on many other jobs. The near-by International industrial dealer or Company-owned branch will give you complete information.

INTERNATIONAL HARVESTER COMPANY
(Incorporated)
180 North Michigan Avenue Chicago, Illinois

INTERNATIONAL Industrial Power

Standard Pipe Makes Safe Struts Or Columns

By W. F. SCHAPHORST

COMMON pipe is convenient for use as columns or struts or for use as "push members" in transmitting forces. Digging around in handbooks, etc., takes considerable time, and as a result a pipe is not used or a pipe much too large or small is used, chosen entirely by guess. The pipe that is too small may fail and cause disaster.

Those who have occasion to use standard pipes in this way may find the following simple table and rules convenient:

1. Knowing the load to be carried and the length of pipe needed, make a guess as to the size of pipe. Column A in the tables will help in making the guess as it gives the maximum length of pipe that may be used. Thus, never use a ⅛-in. pipe longer than 14.5 in. as an important column. Never use a 3-in. pipe longer than 139 inches.

2. Multiply the actual length of the pipe in in. by the corresponding figure in column B of the table. This product should never exceed 12,000. If it does, it means that you have guessed a pipe that is too small. After determining the right size, proceed as follows:

3. Subtract the product from 19,000. If the difference is equal to or less than 13,000 use it in (4). If the difference is more than 13,000 use 13,000 in (4).

4. Multiply by the figure in column C corresponding to the pipe size.

The result is the number of lb. that the pipe will carry as a column, strut, or "push member". If the result is less than the load to be carried, try again, using the next larger size of pipe, and so on until the proper and most economical size is selected.

For example, it is desired to support a load of 10,000 lb. at a height of 84 inches. What size pipe should be used? Following the rules:

1. "Guessing" the size of pipe, in Column A 84 in. falls between 1½- and 2-in. pipe. We shall therefore try a 2-in. pipe.

2. 84 × 126.9 = 10,650. This is less than 12,000 and we shall therefore continue.

3. 19,000 — 10,650 = 8350. This is less than 13,000 and we may therefore use it in (4). If the difference were 18,350, we would use 13,000 in (4).

4. 8350 × 1.07 = 8950 pounds.

As 8950 lb. is less than 10,000 lb. a 2-in. pipe is too small. We shall therefore recalculate, this time trying a 2½-in. pipe.

2. 84 × 105.3 = 8850.

3. 19,000 — 8850 = 10,150.

4. 10,150 × 1.71 = 17,370 lb.

This shows that a 2½-in. pipe would be amply safe to support 10,000 pounds. It shows that a 2½-in. pipe is capable of supporting twice as much as a 2-in. pipe at a height of 84 inches. The small difference in pipe sizes and the great difference in strength indicates the necessity of careful computation and the danger involved in guesswork.

For the benefit of those who wish to check the truthfulness of the foregoing rules, I will state that they are based on the so-called "American Bridge Company formula," which is:

$$S = 19{,}000 - 100\frac{l}{r}$$

Where

S = permissible unit stress in lb. per sq. in., 13,000 lb. per sq. in. being the maximum;

l = length of column in inches;

r = radius of gyration in inches.

These factors are all simple enough for the average engineer who is accustomed to formulas, with the possible exception of the radius of gyration. It is always bothersome to the writer to have to hunt formulas for radius of gyration and no doubt is so considered by others also. I have therefore compiled a table giving the radius of gyration of all standard pipe sections from ⅛ in. to 5 inches. I do not find these tabulated in any handbook and therefore computed them from the formula for concentric sections such as a pipe section, namely:

$$r = \frac{\sqrt{D^2 + d^2}}{4}$$

Using these figures one can quickly compute or check any standard pipe column to and including 5 inches.

For example, using the formula instead of the preceding rules and table and applying it to the same problem, it becomes necessary to guess just the same, formula or no formula, because of the $\frac{l}{r}$ ratio (known as the "slenderness ratio") and because of the na-

Size of pipe, in.	Column A Maximum length, in.	Column B	Column C
⅛	14.5	826.4	0.07
¼	19.4	617.3	0.12
⅜	25.	480.8	0.17
½	31.3	383.1	0.25
¾	40.	300.3	0.33
1	50.6	237.5	0.50
1¼	64.7	185.5	0.67
1½	75.	160.5	0.80
2	94.7	126.9	1.07
2½	114.	105.3	1.71
3	139.	86.21	2.24
3½	161.	74.63	2.68
4	181.	66.23	3.18
4½	202.	59.52	3.68
5	226.	53.19	4.32

Size of pipe, in.	O.D., in.	I.D., in.	Radius of gyration	Cross-sectional area, sq. in.
⅛	0.405	0.27	0.121	0.07
¼	0.540	0.36	0.162	0.12
⅜	0.675	0.49	0.208	0.17
½	0.840	0.62	0.261	0.25
¾	1.05	0.82	0.333	0.33
1	1.315	1.05	0.421	0.50
1¼	1.66	1.38	0.539	0.67
1½	1.9	1.61	0.623	0.80
2	2.375	2.07	0.788	1.07
2½	2.875	2.47	0.95	1.71
3	3.5	3.07	1.16	2.24
3½	4	3.55	1.34	2.68
4	4.5	4.03	1.51	3.18
4½	5	4.51	1.68	3.68
5	5.563	5.05	1.88	4.32

RIDE 'EM COWBOY

YOU'VE GOT TO BE GOOD TO STAY WITH THE TOUGH 'UNS

NO sissy ever broke a bronc. Takes a he-man to even get in the saddle—and steel muscles to stay there. It's like that with the tough oil-well cementing jobs . . . setting a whipstock, for instance. The cement has to set plenty hard, or you're back in the old hole before you know it.

That's where 'Incor' comes in. When you plug-back with 'Incor' the bit always kicks off. Because 'Incor' pumps easily in heavy slurries, and gives high early strength for quick protection. Two or three days after it is run, 'Incor' is harder than the formation. An Oil Man's cement, sure enough.

For deep wells and high temperatures, use 'Starcor'. Delayed set protects against setting up in pipe or tubing. And 'Starcor' also gives extra sulphate resistance.

Select the cement to fit the job: 'Starcor'* for deep holes and high temperatures . . . 'Incor'* for wells of moderate depth . . . Lone Star for construction work above-ground. Portland cements, all—each the quality leader in its own field.

*Reg. U. S. Pat. Off.

TWO PORTLAND CEMENTS— BOTH MADE FOR OIL WELLS

USE 'STARCOR'—for deep wells, high temperatures, extra sulphate resistance.

USE 'INCOR'—for wells of moderate depth, and low temperatures.

ture of the formula and the condition that 13,000 lb. per sq. in. is the maximum allowable unit stress.

Just to check the table and rules let us make a guess this time that a 2½-in. pipe will be adequate.

Then, our table shows that r for a 2½-in. pipe = 0.95 in., whence, substituting in the formula:

$$S = 19{,}000 - \frac{100 \times 84}{0.95} =$$

10,150 lb. per sq. inch.

This, it will be noted, is the same as the result given by "item 3" above.

Then, multiplying by the cross-sectional area of the pipe in sq. in., which is 1.71 sq. in., we get:

$10{,}150 \times 1.71 = 17{,}370$ lb.

Northern Natural Enlarges Its Pipe Line System

RECENTLY the Northern Natural Gas Company made an addition to its system by laying 40 miles of 16-in. O.D. pipe from Ventura, Iowa, to Albert Lea, Minnesota. Pipe was in 40-ft. sections joined by Dresser couplings, a total of 2450 couplings being used.

The line is designed for a maximum working pressure of 450 lb. and the average working pressure is 400 pounds.

The terrain through which the line was laid was undulating and hilly, and

Tractor and boom holding pipe above ditch

the pipe was laid in a trench 28 in. in width and 4 ft. 4 in. to 12 ft. in depth.

Barrett's hot enamel coating and 15-lb. Johns-Manville asbestos felt were applied to the pipe throughout its length. Couplings also were coated but not wrapped, a drain-shield being employed to catch excess coating running off the bottom of the couplings.

The line was assembled above the ditch, Dresser ratchet and torque wrenches being used to tighten the bolts on the couplings, and the latter for inspecting uniformity of torque on all bolts. An average of 125 lengths of pipe was laid per eight-hour day.

The line was given a soapsuds test, 450-lb. shut-in air pressure being maintained for a period of 48 hours.

Steel pipe, of 0.250 in. wall thickness, manufactured by the Republic Steel Corporation, was used in the line's construction.

The J. J. Connor Construction Company, Kansas City, Missouri, was the general contractor.

H. J. Carson is superintendent of operations for the Northern Natural Gas Company.

Pipe sections were joined by Dresser couplings

Special Tools Developed for Diesel Engine Maintenance

Simple equipment designed to facilitate a particular job saves time and reduces possibility of damaging engine

By ORVILLE ADAMS

AN ingenious Diesel-engine operator having an inventive mind and sufficient enterprise develops special tools of various kinds in his own machine shop for use in connection with the operation and maintenance of his engines. Unless he has such tools much time is consumed in pulling pistons, removing bearings, replacing rings, and other general maintenance work.

A special set of tools shown in the accompanying diagrams was developed by James C. Allen, Diesel engineer, Cushing, Oklahoma, and he has already supplied duplicate sets to a number of his friends who operate the same type engines. The sketch in Fig. 1 shows a wrench for removing the nuts from the large cylinder head bolts, to be used instead of the jaw wrench and sledge hammer so frequently employed. This head wrench is made of high-grade steel. There are two parallel holes in the handle, through which are inserted automobile axles to serve as levers. The men stand on the platform deck and operate these levers without the use of sledge hammers. The wrench is not too heavy to handle and may be used without running the risk of damaging parts on top of the engine. Removing head nuts without damage to other parts of the engine requires careful work, and with the use of this wrench the head on a large engine is removed and replaced in much less time than is usually required for the job.

Fig. 1

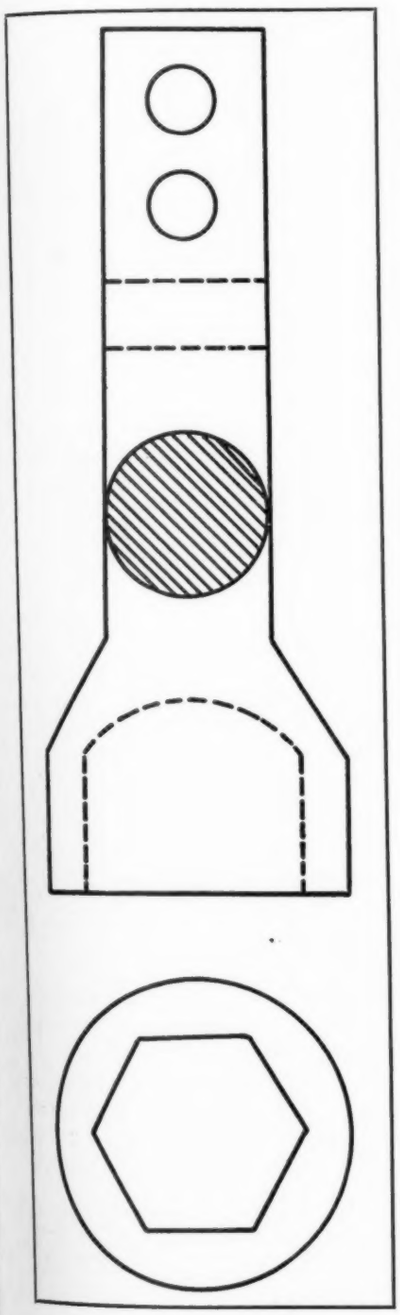
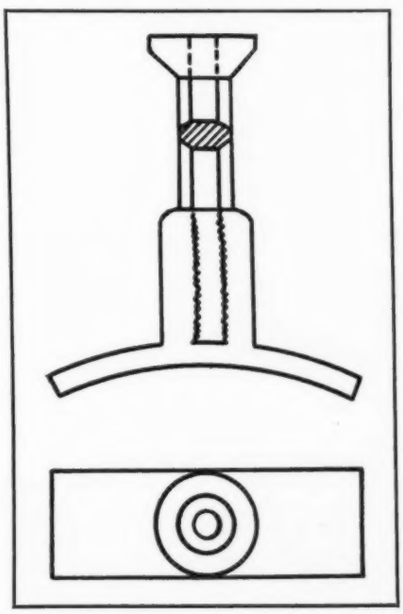


Fig. 2



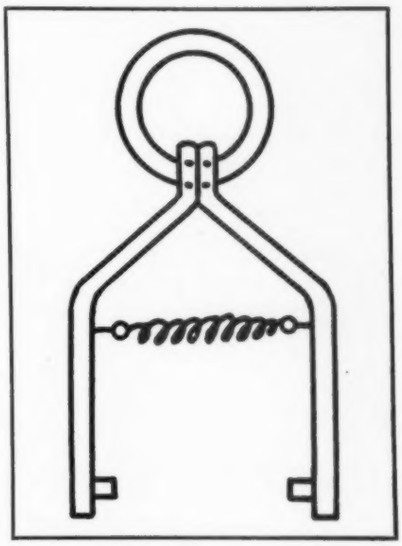


Fig. 3

One difficulty, in particular, which is associated with replacing the head nuts, is avoided as the operator is able to tighten the head nuts without uneven tension being placed on the nuts, a procedure that sometimes results in drawing the cylinder liner out of round. The breakage of other parts that eventually occurs when someone permits the sledge hammer to slip is prevented. The wrench also can be used to remove the nuts without removing the intake and fuel valve on top of the cylinder head, which on many engines interfere with the use of the average wrench.

Fig. 2 shows a tool used in bolting the exhaust header to the cylinder head. This tool is a jack that is placed between the exhaust header and the cylinder head and tightened to spring the header far enough from the cylinder head to permit the insertion of the gasket. This saves time in flanging the exhaust header after the cylinder heads have been bolted in place. The jack is made in such a manner that it does not slip and fall out.

Fig. 3 shows a valve tool employed to pull or replace the exhaust

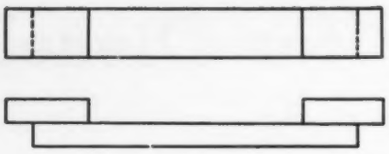


Fig. 4

and intake valves from the valve cages in the cylinder head. It is so constructed as to avoid dropping the valve, and is used in connection with the crane to pull stuck valves. These valves on the large engines are heavy and the job of handling them on top of a large engine proves to be awkward unless some method of using the power hoist is provided.

Fig. 4 shows a board used under the connecting-rod bearing, the bearing bolts being dropped on the board, making it possible to roll out the bearing shell without removing the bearing completely for inspection. The bearing shell may be rolled around, inspected, and returned quickly.

In Fig. 5 is shown a cross-piece used for lifting the valve and head cover and the rocker arms in one assembly. This saves time when removing heads and pulling pistons. The valve-operating mechanism, including rocker arms, is covered with a valve cover on most large engines at the present time, and this valve cover must be removed to reach the head bolts. A method of lifting and moving it with a crane was essential and this tool is the result.

Mr. Allen reports that these tools were designed and built at a cost of about $50.00 per set, and that he has been able to reduce the time required in performing the operations mentioned by one-half to two-thirds.

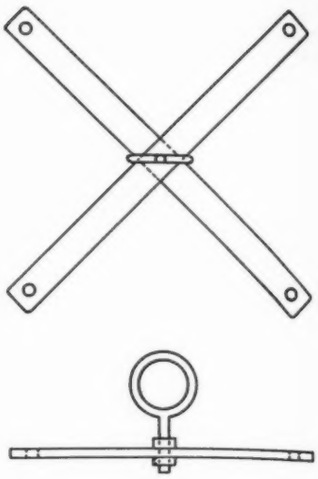


Fig. 5

Calculating Efficiency of Internal Combustion Engine from Number of Explosions

COUNT the explosions of your internal combustion engine, do a little simple figuring, and it is possible to determine with surprising accuracy the efficiency of any engine of the hit-and-miss type of governing.

Subtract the number of explosions per minute made by the engine when it is pulling no load at all from the number of explosions per minute when pulling full load. Then divide the remainder by the number of explosions per minute when pulling full load, and the quotient is the so-called "mechanical efficiency".

For an engine that explodes 95 times per minute when pulling full load, and 24 times per minute when pulling no load at all, the difference is 71. In other words, 71 of the explosions are utilized when pulling full load, whereas 24 of them are lost in overcoming the internal friction in the engine.

Divide 71 by 95 and the quotient tells us that the mechanical efficiency of the engine is a bit less than 75 percent—a rather low efficiency. It should be bettered, and it can be bettered by reducing the number of explosions per minute when running unloaded.

It is sometimes difficult to attain a mechanical efficiency of 90 percent in an engine of this type although 90 percent is common in steam engines, because steam engines are easier to lubricate and the heat problems encountered are not so complex.

Reduction of explosions at no load increases the power of the engine without consuming more fuel. If the number could be reduced from 24 to 10, we would have 14 "useful" explosions to add to the 71, which gives 85 useful explosions. Or, dividing 85 by 95 we now have a mechanical efficiency of 89.5 percent. In other words, the efficiency has been increased from 75 percent to 89.5 percent, or 14.5 percent.

The Cost of Leaking Steam

IF the diameter of the aperture through which steam is leaking is ¼ in., if the cost of fuel is $6.00 per ton, and if the steam pressure is 320 lb. per sq. in. absolute, the loss will amount to $9.60 per day. In one year, leaking day and night continuously, the wasted steam would have a total cost of $3,500.

Although some holes through which steam leaks are not round, it is nevertheless the general practice to compare and discuss leaks in terms of the round hole. Thus we may say of a leak, "It is equal to a leak through an ⅛-in. hole," etc.

To compute the cost of a leak of this kind, use this first class formula: "Square the diameter of the opening in in., multiply by the absolute steam pressure in lb. per sq. in., by the cost of fuel in dollars per ton, and by 0.08." The result is the cost in dollars per day.

This rule is based on Napier's famous formula, which states that to find the weight of steam flowing through a given orifice into the atmosphere per second we have merely to multiply the area of the orifice in sq. in. by the absolute steam pressure in lb. per sq. in. and then to divide by 70.

In developing the above rule, it was assumed that 1 lb. of fuel will evaporate 6 lb. of water.

THE BEST —WHICH DRILLING METHOD IS?

Fig. 524

TO ask in general terms what method of drilling is "best" is like asking "how long is a pipe line?" In general terms, there is no answer.

Where is the property? What is the transportation problem? What is the nature of the foundations, what is the fuel, where are the water sources? Are the production zones definitely known, and how deep are they? Are there stray possibilities? Are the pressures low? What part does time really play in the economics of the problem?

Every one of those factors should be taken into consideration. Carefully analyzed, they will *tell you* which drilling method is the economical one, the better one, for the well in question.

In drilling a well, the fundamental problem is one of economy. Whatever method you may use, reliable equipment and a capable crew are necessary. An analysis assuring these, with your own requirements definitely in view, will enable you to compare, decide, and then proceed, knowing that the method you adopt is the best for your particular job.

Fig. 511

Cable-system drilling is economical only with good equipment, properly maintained . . . and good equipment includes good tools. Spang Cable Tools are the standard of comparison for good tools the world over.

SPECIFY **SPANG**

CABLE TOOLS

The HIGHER STANDARD

Control of Heaving Shales By Blasting

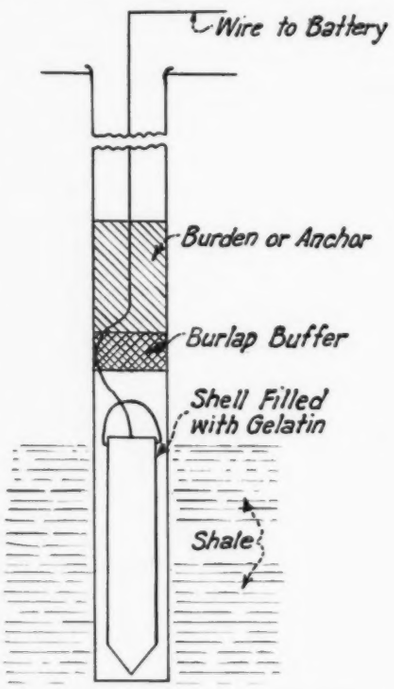
Firing of small charge of gelatin stiffens wall of well temporarily, permitting completion of well

By F. R. COZZENS*

IN Ohio, West Virginia, and Kentucky, at an average depth of 600 ft., the driller invariably encounters waxy shales that behave much like quicksand. The walls do not stand firm, but slip and crumble the moment an opening is made. The thickness of the shale ranges from 30 to 70 feet. The formation is known as the "Big Red". A similar stratum is found in mountainous regions at a greater depth, and is termed "Soap Rock". In other localities, and at various depths, these formations are called "Pink stone", "putty-rock", "Devil's jelly", etc., but regardless of name or location, the strata bear the same grainless texture, and it is virtually impossible to drill through them unless special equipment is used.

To the layman it might seem that explosives would be of little value in controlling grainless shales, because the primary purpose of blasting is to break and crumble, but in some oil-producing districts commercial explosives are being used for the opposite purpose. Instead of crumbling the walls, the force of the blast is made to stiffen them so that drilling may proceed without interruption.

A typical example of the practice is the procedure used in drilling the Blosser well, at Laurel Creek, near Liberty, Ohio. Shales are especially treacherous in that district, and the first troublesome formation was encountered at a depth of 560 feet. When drilling had proceeded but 12 ft. into the formation progress became so difficult that the operator lifted the drill and prepared a torpedo, the shell of which was made from an 8-ft. section of metal rainpipe, closed at the bottom, and provided with a bail in the top. Into this shell were loaded end to end, twelve 1¼-in. by 8-in. cartridges of ammonia dynamite, 40 percent strength. Into the top cartridge was inserted a No. 6 electric blasting cap, which was connected by an insulated copper wire of sufficient length to reach well beyond the top of the hole to the firing battery. The wire was looped into the bail of the torpedo and the shell was lowered to the bottom of the hole. A wadding of burlap was pushed gently down on top of the shell, and about 100 lb. of dry sand was poured upon the burlap as stemming for the charge. The wire was then drawn taut, and the charge was fired by a battery on the derrick platform. A suction bailer was used to remove the spoil or residue and drilling was resumed for an additional 15 ft., where a sceond torpedo, containing ten 1¼-in. by 8-in. cartridges of ammonia dynamite, 40 percent strength, was exploded. The remaining 7 ft. of formation was drilled without interruption, and the top walls remained firm until casing was set 24 hours later at a depth of 700 feet. Similar formations drilled later at greater depths were treated with torpedos containing eight to ten cartridges of ammonia dynamite, same strength. Final results showed a saving of at least 60 hours plus a $20 saving of fuel and incidentals, or an estimated total saving of $65.00, over and above the cost of dynamite and the time required for loading it.



Method of tamping and firing explosive

The principle of the torpedo practice is to stem the charge in such manner that sufficient force is exerted against the side walls to make them firm and sear them for a short time. In most shales the effect would probably last less than 60 hours, but that length of time is quite sufficient in which to reach a satisfactory reducing point and insert casing. The risk of sticking a bit, losing the drill, cable breakage, etc., resulting in costly "fishing" jobs, is almost eliminated and there is less need for jars, bumpers, and similar accessory equipment.

Ammonia dynamite is generally used for the purpose as it gives better results in wet holes. In wells of a diameter exceeding 10 in., 4-in. by 16-in. and 4-in. by 8-in. cartridges of gelatin, 60 percent strength, are being used effectively, and some operators prefer the straight nitro-glycerin gelatin in holes that have been drilled to a depth of 800 feet. For best results, shooting should be done before caving becomes serious, as the larger the cavity, the less pressure can be exerted against the walls. To prevent delay, most operators have several torpedo shells prepared in advance. When one is needed it takes but a moment to insert the blasting cap and attach the wire, making it ready for its descent down the hole. The torpedo is usually made by the workers themselves, and the average cost, including wire and cap, is about $3.00.

*The Equity Oil and Gas Company, Stockport, Ohio.

Frick-Reid
CHRISTMAS 1938

Abstracts of A. P. I. Papers, 19th Annual Meeting . . . Chicago . . . November, 1938

Catalytic Processing of Petroleum Hydrocarbons by the Houdry Process

By EUGENE HOUDRY, Houdry Process Corporation, Wilmington, Delaware; WILBUR F. BURT, Socony-Vacuum Oil Company, Inc., New York, New York; A. E. PEW, JR., Sun Oil Company, Philadelphia, Pennsylvania; and W. A. PETERS, JR., E. B. Badger and Sons Company, Boston, Massachusetts

THE paper indicates the present commercial status of the Houdry catalytic processes for petroleum-hydrocarbon refining. These processes involve complete catalytic operations for production of high-octane motor fuels and aviation gasolines by cracking of gas oils, residuums, and crude oils with or without fuel-oil production. Included also are brief descriptions of catalytic liquid-phase viscosity reduction of tars, polymerization of butenes, vapor-phase and liquid-phase catalytic treatment of gasoline and aviation fuels, and de-sulphurization of gases by catalytic action. Yields and qualities of products are given. Types of catalysts used and methods of operation are described in general terms. Effects from the standpoint of conservation and economies are discussed.

The Determination of Yield Per Pass, Time of Treatment, and In Situ Density, and Instrumentality for Their Control in Commercial Cracking Units

By ROBERT L. RUDE, British American Oil Company, Ltd., Toronto, Canada; RAYMOND D. JUNKINS, Bailey Meter Company, Cleveland, Ohio; and COLIN BARNES, University of Toronto, Toronto, Canada

THE time of treatment in cracking is determined from measurements of density *in situ* of the fluid in the conversion section. The density is determined from the known weight rate of furnace charge and the differential head developed at adjustable orifices installed in the path of flow. Tests conducted on commercial cracking units have provided data permitting the empirical correlation of time, temperature, stock characteristics, and yield per pass. On the basis of this correlation, instruments have been developed for the continuous control of the cracking operation. The tests showed further that the density at the outlet of the conversion section is an index of the total heat in the synthetic crude, and that this heat can be varied over wide limits while maintaining a desired yield per pass.

The Suitability of Several Casing Steels for Field Welding

By L. R. HODELL, The Carter Oil Company, Tulsa, Oklahoma

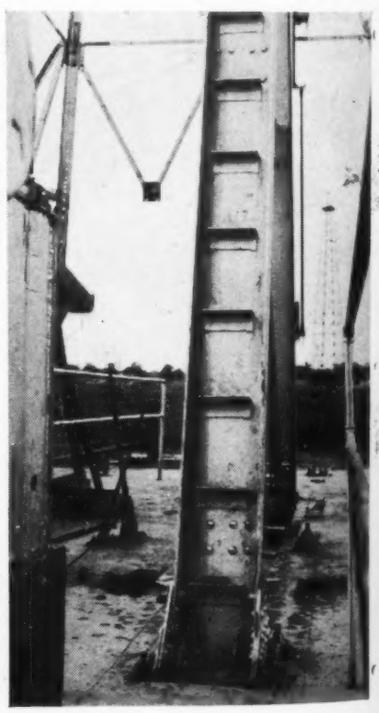
APPROXIMATELY 200 joints of casing representing 6 different steels have been welded under field conditions, and quenched at varying time intervals after breaking of arc. Results indicate that the various steels respond differently to the quenching. As a result of comparing manners in which they respond with the exigencies of field practices, certain of these steels are considered weldable and certain others are not weldable when used in the field welding of casing. In order to establish a standard, a test procedure has been proposed for the purpose of determining the field weldability of various casing steels.

Permanent Ladder for Pumping Units

A LADDER that cannot be "borrowed", mislaid, or carried away, but represents only a small initial outlay in materials and labor provides access to the beam bearings on one long-stroke pumping unit in the Talco field.

In the channel section that forms one leg of the A-frame carrying the beam bearings, short lengths of 2-in. by 2-in. angle iron are welded to form an inclined ladder or steep stairway, the flanges of the channel serving as handgrips for the operator climbing the frame.

As the length of the angle iron is less than the distance between the flanges of the steel supporting member, the steps are protected against damage and the corners of the angles are shrouded so as not to protrude and perhaps injure the switcher.



A sturdy, safe servicing ladder is formed by these welded steps of angle iron between the flanges

Method of Testing the Adequacy of Electrical Grounds

By CLARENCE A. ANDERSON*

The a-c. is superior to the d-c. as a general-purpose method of testing

GROUND testing has become an important factor in the operation and protection of some equipment used by oil pipe-line companies. The writer proposes to show in this article that the a-c. method of testing the condition of grounds is more reliable for general purposes than the d-c. method commonly used. It is the contention of the writer that, for practical reasons, grounds for a-c. use should be tested with a-c. testing apparatus.

Service grounds are used principally for two reasons; first, as protection against lightning and high-potential hazards, and second, to provide a return path for circuits embracing electrical equipment of various types. Earth resistivity or ground testing also enters into the study of corrosion problems relative to buried oil lines, but that is another story.

The idea that a piece of iron or a plain rod driven a few feet into the earth will serve as a satisfactory "year around" ground has long been discarded. Experience has taught us that seasonal changes in conditions defeat the purpose of well-intended grounds. These seasonal conditions are, in part, freezing weather, drought, and deterioration due to chemical reaction of the soil. Operating companies, therefore, cannot rely on the stability of installed grounds unless the grounds are periodically checked. Several examples will be cited subsequently to show why the d-c. method alone is not sufficient for general ground testing.

When we consider that the frequency of voice currents exceeds 1500 cycles at top range and that certain types of ringing equipment require 1000 cycles for operation, it is obvious that impedance in the ground circuit can be an obstacle to the satisfactory performance of equipment. Inasmuch as lightning and most high-potential hazards are of high frequency, the same reasoning likewise will apply to protective measures.

After carefully considering different problems involving the testing of grounds, the writer, to combat the situation to the best advantage, provided himself with testing apparatus capable of producing an electrical wave of an unusual character especially effective for ground testing. This test wave was so sharp that, when gauged by the ear, resistance readings could be obtained to a small part of an ohm. The receiver also served as a good medium for detecting such defects in the circuit as might be caused by impedance due to iron. The principle used for testing involved an induction balance. When an artificial resistance in one arm of an induction bridge circuit is varied to equal the non-inductive resistance of the circuit under test a neutral or balanced point will be observed in the head receiver. The electrical wave for testing was produced by a magneto test set operated with one hand, the other hand being used to find the balancing point on the variable resistance dials.

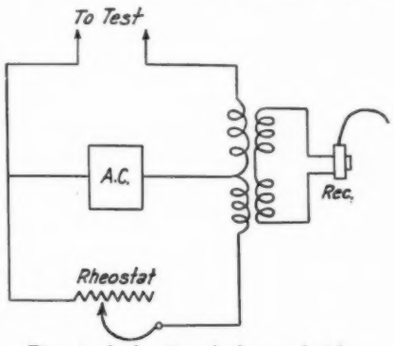


Fig. 1. Induction balance bridge circuit

Fig. 1 shows the induction balance bridge circuit. Fig. 2 shows the character of the test wave and the effect produced in the head receiver. Fig. 3 shows the induction balance bridge test set and variable resistance rheostats reading to 1000 ohms. Fig. 4 shows the triangular method of computing ground resistance when tests are made at three points of contact.

Method of Operation

The leads are first connected to the ground to be tested and the head receiver clasped to the ear by means of a head band. The magneto test set is turned with one hand as the other hand manipulates the dials of the rheostats until a silence or minimum tone is observed in the head receiver. The values shown on the dials correspond to those on a wheatstone bridge. The set is easily operated and direct readings can be

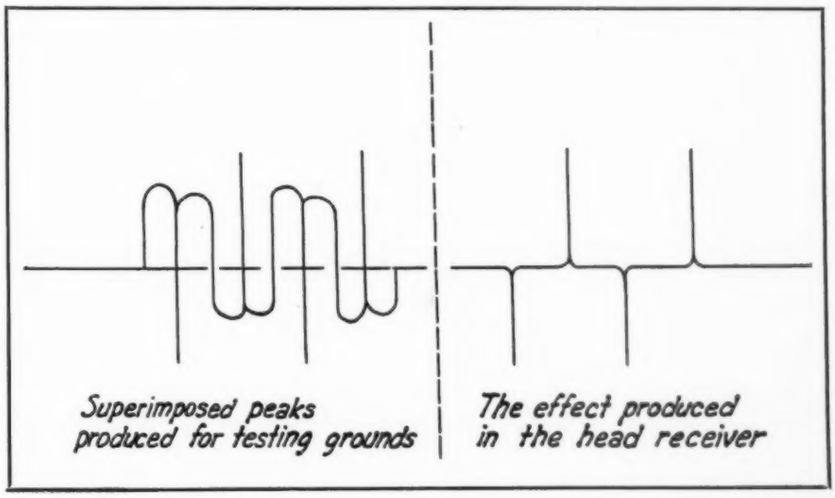


Fig. 2. The character of ground testing wave

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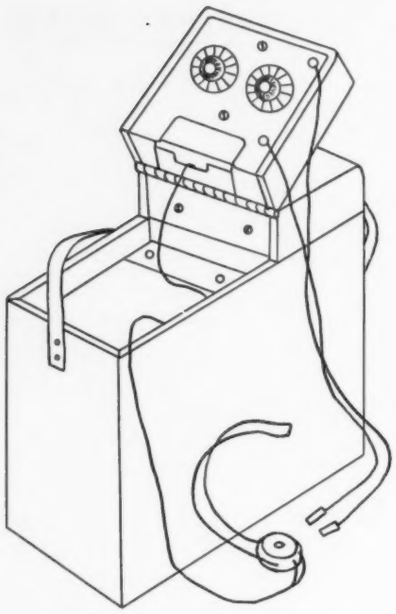

Fig. 3. Ground testing device

made on non-inductive circuits. A periodical check on all service grounds has become a part of the regular routine of many companies to determine their efficiency.

Dried, frozen, or corroded ground contacts may result in much expense or even injury to human beings, as a great deal depends on a good ground. The importance of proper grounding can perhaps be best exemplified in the following cases that the writer experienced in checking grounds.

1. In an office ground check in which a-c. telegraph was involved, the test set revealed an irregularity. The usual sharp peaks (referred to as test tone) were lacking in the head receiver. The test tone was somewhat flat and a positive balance could not be indicated by the dial readings. The grounding was checked and was found to consist of an iron pipe over which, owing to dry weather, the current was forced to travel a considerable distance before reaching actual ground. This iron offered impedance to alternating current. When proper grounding was effected operation of the equipment was improved.

2. Sometimes companies find that seemingly good grounds fail in times of stress. A company operating telephone and telegraph circuits had provided a guard wire to protect a lead over which a 2300-volt power line crossed. This guard wire was supposed to have been well grounded for safety; in event the power line came down it would, upon touching the guard wire, cause the cutout to function at the power station. A 16-ft. ground rod had been installed for the purpose and it was reported to have been satisfactory at the time of installation. The 2300-volt power line did fall during a storm and because the grounding of the guard wire was ineffective much damage was done to the telephone and telegraph equipment. The question then arose as to who was at fault for the poor ground and the writer was called to check the service ground with an a-c. test set. There was no argument about there being a 16-ft. ground rod; the trouble was that it had been driven into a gravel bed. The resistance of the ground did not test high but there were indications of what is sometimes called a "jumpy" ground because it did not test firm with a-c. and sounded as though it were arcing. To correct the fault it was necessary to run a copper cable some distance before a suitable ground was found.

3. In checking several outside terminal grounds installed to protect electrical equipment against lightning, it was found that iron had been used instead of copper. This is inadvisable because the impedance offered by even a small amount of iron often is a barrier in the path of lightning seeking earth. Tests proved this to be true so the iron was replaced by copper.

4. Many ground rods are not installed deeply enough to meet extreme conditions in dry or cold weather. Our test showed that 6-ft. rods were sometimes used where 8-ft. rods were needed for year-around protection. The extra 2 ft. may mean the saving of much expense and trouble. This does not mean, however, that 8-ft. grounds are safe in every case so a check should be made periodically to reveal their true condition at all seasons. The triangular method illustrated in Fig. 4 was used in checking ground rods. To facilitate ground testing, a long-shanked drill bit can be drilled into the ground with an auger brace and used as a test ground. This can be made from a 5/16-in. piece of copper weld to one end of which a ⅜-in. bit can be welded, the holder being welded to the other end. Two test rods can be easily driven into the ground for use in testing by the triangular method.

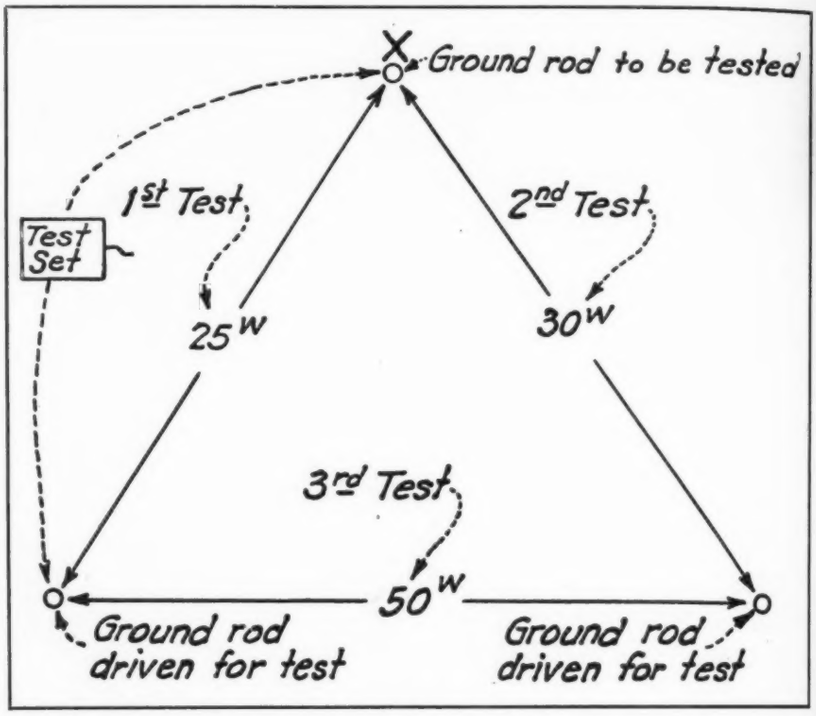

Fig. 4. Triangulation or three-point test for grounds.

Example: $X = \frac{25 + 30 - 50}{2} = 2.5^{w}$ (resistance of top ground rod)

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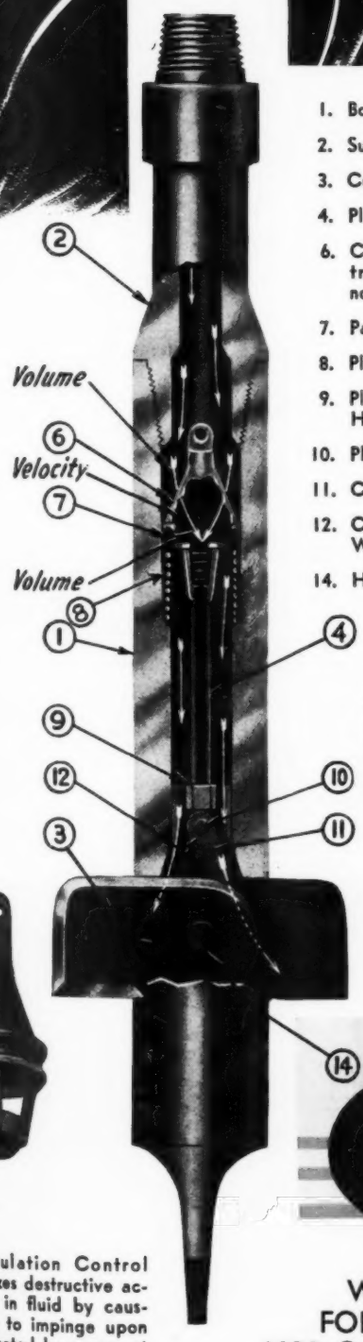

1. Body
2. Sub
3. Cutter Blades
4. Plunger Rod
6. Circulation Control Head (see note)
7. Packing Ring
8. Plunger Spring
9. Plunger Link Head
10. Plunger Link Pin
11. Connecting Link
12. Connecting Link Washer
14. Hinge Pin

By using the GRANT Hydraulic Wall Scraper, the operator effects a double saving. First, there is a distinct saving in time and labor costs due to its extremely low upkeep and maintenance expense . . . Saving in repair and upkeep bills quickly pays the entire cost of the tool. Second, the surpassing efficiency of the GRANT Hydraulic Wall Scraper assures faster scraping or reaming, plus troubleproof and continuous operation from the time it enters the hole until the job is finished.

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Sample Computations of Natural Gasoline Absorber Data

Calculation of absorber tower capacity, probable analysis of product, and other factors demonstrated

By R. H. TURNER

THE capacity of bubble towers is dependent upon several factors, among which are:

1. Distance between trays or plates.
2. Molecular weight of the gas or the composite vapors being treated or processed.
3. Absolute operating pressure.

Another important factor in calculating these capacities is the quantity of liquid passing downward through the bubble tower or fractionating column and the depth of this liquid on the plates. This latter consideration will be treated separately.

1. Distance Between Plates:

The distance between trays can be varied and the velocity changed to meet these requirements, but after years of experience it has been found that a spacing of approximately 18 in. is the most economical in gasoline plants and a slightly greater spacing in some refinery services, particularly where manholes are to be installed. This spacing can be increased and the tower diameter decreased, but there is no saving in cost of fabrication, as with the increased tray spacing the tower would have to be higher.

2. Molecular Weight of the Gas or Vapor:

The molecular weight of the gas or the vapors being processed is merely another way of expressing density, and as this increases the shell and cap velocities must decrease, other conditions remaining the same. In other words, a tower will process a greater quantity of gas having a molecular weight of 30, such as natural gas, than of one having a molecular weight of say 125.

3. Absolute Operating Pressure:

The absolute operating pressure determines the number of actual cu. ft. of gas passing, which in turn gives actual density.

In bubble towers, the allowable shell velocity is 2 ft. per sec. at atmospheric pressure and 18-in. tray spacing for a fluid of a molecular weight of 125. Further, this velocity varies as the ratio of the square root of the molecular weights and also as the ratio of the square root of the absolute operating pressures. Consequently,

$$\frac{\sqrt{125}}{\sqrt{30}} = 11.20/5.45 = 2.06 \times 2.0$$

$$= 4.12 \text{ ft. per sec.}$$

4.12×0.80 (factor safety) $= 3.296$ ft. per sec. at atmospheric pressure, or, at 30-lb. gauge,

$$3.296 \times \frac{15}{45} = 1.90 \text{ ft. per sec.}$$

In calculating bubble towers, it is necessary to calculate the pressure drop across the trays in order to arrive at the total pressure loss through the entire column. Ordinarily in almost any service a pressure drop of 2.0 lb. is satisfactory and on this basis is calculated the allowable cap velocity in a 16-plate absorber to give this figure.

$2.0/16 = 0.125$ lb. per tray.

Use 0.10 lb. per tray.

$u = c\sqrt{2gh}$

$c = 0.30$ (constant); $2g = 64.4$

Use molecular weight of 125 and atmospheric conditions.

$125/380 = 0.329$ lb. per std. cu. ft.

$h = 0.10/0.329 \times (144) = 43.7$

$u = 0.30\sqrt{64.4 \times 43.7}$

$= 0.30\sqrt{2820} = 15.90$ ft. per sec.

Using a molecular weight of 30 and atmospheric pressure,

$30/380 = 0.079$ lb. per std. cu. ft.

$h = (0.10/0.079) \times (144) = 182$

$u = 0.30\sqrt{64.4 \times 182} = 0.30 \times 108 = 32.40$ ft. per sec.

These calculations are based on the assumption that the absorber is treating gas having a molecular weight of 30, or natural gas. It might be stated here that the temperature of operation must also be taken into consideration by correcting the density of the gas or composite vapors passing.

Consequently, from these calculations, it can readily be seen that the capacity of any bubble tower can be calculated and also the resultant pressure drop across the trays. The latter was arbitrarily chosen as 0.10 lb. per tray, but if it is desired to have this larger or smaller, the corresponding cap velocity can be calculated in the same manner.

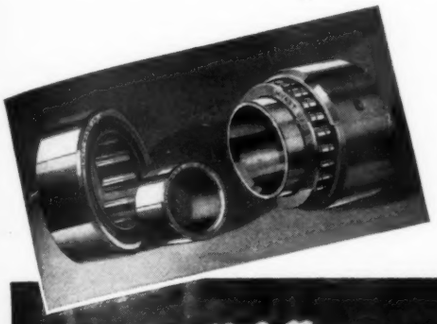
Suppose it is desired to calculate the capacity of a 32-in. I.D. absorber, treating gas of a molecular weight of

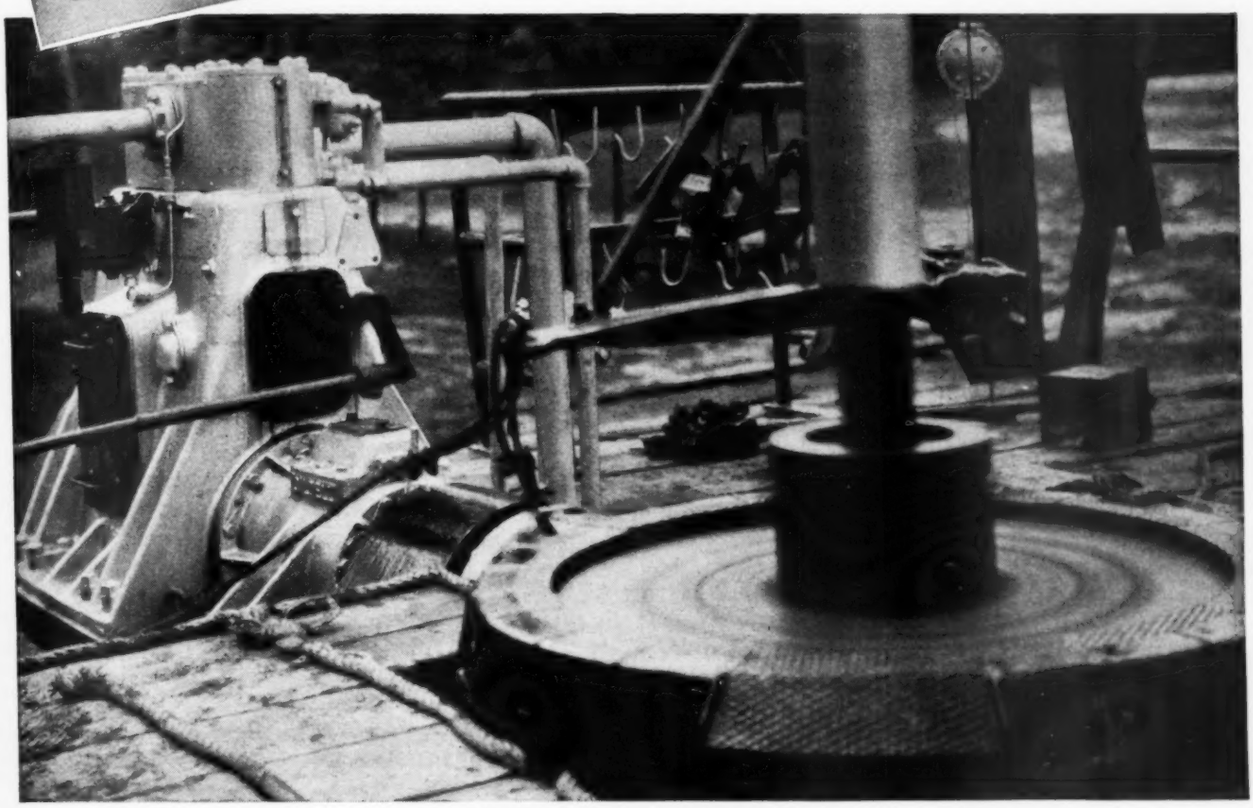
TABLE I

Capacity, 1000 cu. ft. of gas or vapor per bubble cap per 24 hr. of continuous operation

Gal. of oil circulating per 1000 actual cu. ft.	Density of vapor or gas, lb. per actual cu. ft.										
	.02	.06	.10	.20	.40	.60	.80	1.0	2.0	4.0	6.0
30	170	155	145	130	115	105	97	90	76	63	55
35	155	140	130	120	105	95	87	80	70	57	50
40	145	130	120	110	96	87	80	74	63	52	46
45	135	120	110	100	90	80	75	69	59	48	42
50	125	110	105	95	83	75	70	64	55	45	40
55	115	105	97	90	78	71	65	60	52	42	37
60	110	100	93	85	74	67	62	57	49	40	35
65	105	95	88	80	70	64	59	54	46	38	33
70	100	90	84	76	67	61	56	52	44	36	32
75	95	85	80	73	64	58	54	49	42	35	30
80	92	82	77	70	62	55	51	47	40	33	29
85	88	80	74	67	60	54	49	45	39	32	28
90	85	76	72	65	57	52	47	44	38	31	27
95	82	73	69	63	55	50	46	42	37	30	26
100	80	71	67	60	53	48	44	41	35	29	25
125	69	62	58	52	46	42	38	36	30	25	22
150	61	55	51	47	41	37	34	32	27	22	19
175	55	50	46	42	37	33	31	29	24	20	17
200	50	45	43	39	34	31	28	26	22	18	16
250	44	40	37	34	30	27	24	23	19	16	14
300	39	35	33	30	26	24	22	20	17	14	12
350	35	32	30	27	24	22	20	18	16	13	....
400	32	29	27	25	22	20	18	17	14	12	....

Scarcely aware of their presence . . . so efficiently do Hyatts serve





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30 and at a pressure of 30 lb. gauge (45 lb. abs.).

$3.1416 \times 256 = 805/144 = 5.60$ sq. ft. cross-sectional area.

$5.60 \times 3.296 = 18.50$ std. cu. ft. per sec.

$18.50 \times 86{,}400$ (sec. per 24 hrs.) = 1,595,000 std. cu. ft. per 24 hrs.

At 30 lb. gauge pressure (45 lb. abs.)

$$\text{Allowable velocity} = 3.296\frac{15}{45} = 1.90$$

ft. per sec.

$1.90 \times 5.60 \times 86{,}400 = 920{,}000$ act. cu. ft. per 24 hrs.

$920{,}000 \times 45/15 = 2{,}760{,}000$ std. cu. ft. per 24 hrs.

Consequently, for a 60-in. absorber treating gas under the same conditions:

$3.1416 \times 900 = 2830/144 = 19.70$ sq. ft. cross-sectional area.

$19.70 \times 1.90 \times 86{,}400 = 3{,}230{,}000$ act. cu. ft. per 24 hrs.

$3{,}230{,}000 \times 45/15 = 9{,}690{,}000$ std. cu. ft. per 24 hrs.

Heretofore, nothing has been said about the variation of bubble tower capacities as related to liquid circulation. This can be more readily seen in the accompanying chart, which is very handy for personal use. (Table 1.)

In Table 1 the capacities are given in 1000 actual cu. ft. per cap per 24 hours. The cross-sectional area of the cap open to flow to the gas or vapor is approximately seven sq. inches. The nominal number of caps in towers of different diameters is as follows:

24 in.— 6 caps
32 in.— 12 caps
40 in.— 16 caps
48 in.— 26 caps
60 in.— 40 caps
72 in.— 58 caps
84 in.— 80 caps
96 in.—105 caps
108 in.—129 caps
120 in.—160 caps

It can readily be seen that as the cross-sectional area of the cap used is decreased or increased, the number of caps in any given diameter of tower will increase or decrease. It can further be seen that by the above, the correctness of the diameter of any tower can be determined.

To explain more fully the use of the chart, the following example is given and solved:

Gas capacity = 18,000,000 std. cu. ft. per 24 hr.

Gas mol. wt. = 30

Operating press. = 30 lb. gauge (45 lb. abs.).

Gal. of oil per 1000 act. cu. ft. of gas being circulated = 100

Calculate the absorber capacity needed:

$18{,}000{,}000 \times 45/15 = 6{,}000{,}000$ act. cu. ft. per 24 hr.

Gas density $30/380 = 0.079$ lb. per std. cu. ft.

$0.079 \times 45/15 = 0.237$ lb. per act. cu. ft.

Enter chart at 100 as an abscissa and 0.237 as an ordinate. By interpolating it is seen that each cap under the above conditions will handle approximately 80,000 act. cu. ft. of gas or vapor per 24 hrs.

Therefore, $6{,}000{,}000/80{,}000 = 75$ caps required to handle the amount of gas.

Consequently,

One 84-in. unit having 80 caps, or two 60-in. units having the same number of caps would serve. The first would be more economical from the standpoint of first cost, however.

It seems unnecessary to say that the oil circulation of a gasoline plant is one of its most important factors and should be determined as accurately as possible. The formula to determine this circulation is as follows:

Oil rate, gal. per min. $= A \times M \times V.P./(18 \times P.)$

M = number of 1000 cu. ft. of gas to be treated per day.

V.P. = Vapor pressure, lb. per sq. in. abs. of iso-pentane at the temperature of the fat oil leaving the absorber.

P = Absolute outlet absorber pressure, lb. per sq. in.

A = Absorption factor, 1.40 for a 16-plate absorber and 1.60 for a 12-plate unit.

It can readily be seen that it is possible by using the above formula to determine the oil rate for any given set of conditions. Remember, at the same time, that for each percent saturation of the fat oil there is an increase in its temperature of approximately 2.5 deg. fahr. over the temperature of the lean oil. In other words, for a 4.0 percent fat oil saturation, its temperature would be ten deg. fahr. higher than that of the lean oil entering the absorber. The vapor pressure of iso-pentane used in the above formula would be that at this latter temperature. If the gas analysis shows none of this constituent, it is satisfactory to use the vapor pressure of the pure pentane fraction in the formula.

To calculate the fat oil saturation, the following formula is useful:

$$\text{Percent fat oil sat.} = \frac{\text{Gal. gasoline produced per day}}{\left(\begin{array}{c}\text{Lean oil circulation gal. per}\\ \text{day} + \text{gasoline produced}\end{array}\right)} \times 100$$

Often it is necessary to calculate the quantities of the different hydrocarbon fractions that condense under specific conditions of temperature and pressure in the presence of other hydrocarbons and, likewise, the quantities of these same fractions that would weather under other conditions of operation.

Condensation:

π = Absolute pressure

P = Vapor pressure of pure component

Z = Mols of component in liquid

N = Total number of mols of liquid condensed

$\frac{Z}{N}$ Mol fraction in liquid X_n

$$\frac{\text{Total mols of component} - Z}{(100 - N)} =$$

mol fraction in gas Y

From Raoult's and Dalton's Laws:

$X_n P = Y_n \pi$

$N = Z_1 + Z_2 + Z_3 + Z_4 + Z_5 \ldots\ldots Z_n$

$ZP/N =$

$$\frac{\text{Total mols of component} - Z\pi}{(100 - N)}$$

$N/100 - N = ZP/(\text{Total mols of component} - Z)\pi$

Example:

Pressure, 315 lb. absolute
Temperature, 90 deg. fahr.

Gas	Mols or Percent	V.P. at 90 deg. fahr.
Methane and air	62.43	4150
Ethane	9.14	725
Propane	17.77	155
Iso-butane	2.03	59
N-butane	3.81	43
Pentanes	4.82	82

$$\frac{N}{100 - N} = \frac{Z_1 \times 4150}{315\,(62.43 - Z_1)} = \frac{13.18\,Z_1}{(62.43 - Z_1)}$$

$$\frac{N}{100 - N} = \frac{Z_2 \times 725}{315\,(9.14 - Z_2)} = \frac{2.3\,Z_2}{(9.14 - Z_2)}$$

$$\frac{N}{100 - N} = \frac{Z_3 \times 155}{315\,(17.74 - Z_3)} = \frac{0.492\,Z_3}{(17.74 - Z_3)}$$

$$\frac{N}{100 - N} = \frac{Z_{4\,iso} \times 59}{315\,(2.03 - Z_{4\,iso})} = \frac{0.1872\,Z_{4\,iso}}{(2.03 - Z_{4\,iso})}$$

$$\frac{N}{100 - N} = \frac{Z_4 \times 43}{315\,(3.81 - Z_4)} = \frac{0.1365\,Z_4}{(3.81 - Z_4)}$$

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12,000 Feet of Hole with One set of DI-HARD LINERS!

Gentlemen:

I wish to make this statement in connection with the use of your Di-Hard I. R. Metal Slush Pump Liners, which we have been using in a No. 18 Wilson-Snyder Pump Liners, which we have time we purchased this pump, we installed Di-Hard Liners and put them in operation in the North Pettus Field, in Bee County. We drilled eleven 3700-foot wells, then moved to the Driscol Field, in Nueces County and drilled a 6000-foot well. Then moved near Columbus, in Colorado County, and drilled a 6000-foot well there. Then moved to Fremont, in Jim Wells County, and drilled a 3500-foot well there. Then moved to Brownsville, in Cameron County, and drilled a 7600-foot well. Moving from there to McFaddin, in Victoria County, and drilled a 6000-foot well. Then moved to the Plummer Field, in Bee County, and drilled a 2500-foot well, this making a total of 72,300 feet of hole drilled with one set of liners and the pump is still in operation, and as yet, the liners are giving good service.

We feel that these liners have saved us considerable money and the replacement of pistons, due to their very satisfactory service.

It is with pleasure indeed that we are writing this letter concerning our service in connection with this product sold by you in connection with your other equipment that we are using very satisfactorily.

Yours very truly,

HENSHAW BROTHERS, INC.

By Walter A. Henshaw

Walter A. Henshaw

MORE PROOF OF EXTRA SERVICE

15 WELLS PER SET OF DI-HARD LINERS

"We have been using your 'Di-Hard' liners in our slush pumps for the past two or three years. The fact that we now have all our pumps equipped with these liners is excellent proof that they have given us satisfaction.

"In Western Kansas, for example, each set of liners is drilling fifteen or more wells. This is indeed a great improvement over the length of life of liners formerly used in our pumps."

writes Seth W. Herndon, President Herndon Drilling Co., Tulsa.

43,880 FT. WITH ORIGINAL LINERS

"We believe you'll be interested in the excellent service we received from two sets of 7¼x14" 'Oilwell' Di-Hard Pump Liners.

"The original set of liners had made 43,800 feet of hole when they were replaced. The second set has made 25,450 feet of hole and is in first-class condition. We expect many more feet of service."

says L. T. McDaniel, Tool Pusher of The L. E. Douglass Oil & Gas Co., Hutchinson, Kan.

53,700 FT. WITH ONE SET OF DI-HARDS

"July 1936, we bought these six-inch Di-Hard Liners as regular equipment with a 6 x 16 Wilson-Snyder pump. These liners were replaced for the first time during January 1938.

"We made a total footage of 53,700 feet with these liners during the time they were in service."

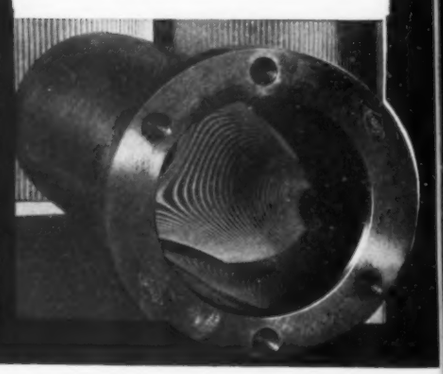
writes C. A. Moore of Troup-Moore, Drilling Contractors, Holdenville, Okla.

DI-HARD LINERS SAVE WEAR AND TEAR ON PUMP

"I used two sets of regular liners in Oil Well and Wilson-Snyder pumps in my drilling operations in Moore County on one well.

"Using D-Hard Liners, I drill approximately six wells using but one set. A proportionate savings is effected in wear and tear on pump heads. I consider this very satisfactory service."

J. R. McGill, Drilling Contractor, Amarillo, Texas.



OIL WELL SUPPLY COMPANY

Subsidiary of United States Steel Corporation

Branch Stores in all Oil Fields

"OILWELL"

$$\frac{N}{100-N} = \frac{Z_5 \times 8.20}{315\,(4.82 - Z_5)} = \frac{0.026\,Z_5}{(4.82 - Z_5)}$$

By Trial and Error

N	$\frac{N}{100-N}$	Z_1	Z_2	Z_3	$Z_{4\ iso}$	Z_4	Z_5	$\Sigma Z = N$
10	0.111	0.521	0.421	3.27	0.757	1.715	3.95	10.594
12	0.134	0.639	0.511	3.86	0.855	1.906	4.05	11.821
11.50	0.13	0.609	0.489	3.71	0.832	1.855	4.02	11.515

Different values of "N" are assumed and the proper solution of the problem is obtained when "N" exactly or very nearly equals the sum of $Z_1 \ldots\ldots Z_5$, or ΣZ_n. (11.50 = 11.515)

Therefore, in this problem the following quantities of the fractions shown will be condensed:

Methane, CH_4, 0.609/62.43=0.965 percent.

Ethane, C_2H_6, 0.489/9.14 = 5.36 percent.

Propane, C_3H_8, 3.71/17.77=20.90 percent.

Iso-butane, $C_4H_{10\ iso}$, 0.832/2.03 = 41.40 percent

Butane, C_4H_{10}, 1.855/3.81 = 48.70 percent.

Pentanes (+), C_5H_{12}, 4.02/4.82 = 83.40 percent.

If the total quantity of the gas is known, the number of cu. ft. of the different fractions condensing can be readily calculated and the number of gal. computed therefrom.

Weathering:

W = Mols of component in vapor

N = Total mols in liquid

π = Absolute press., lb. per sq. in.

P = Vapor press., absolute, of pure component

100 — N = Total mols in vapor

$\frac{W}{100-N}\,\pi$ = Partial pressure in vapor

$\frac{\text{Mols of component} - WP}{N}$ = Vapor press. of component from liquid

$\frac{W}{(100-N)} = \frac{(\text{Mols of component} - W)\,P}{W\,\pi}$

$100 - N = W_1 + W_2 + W_3 \ldots W_n$

These equations are solved in the same manner as those of the condensation reaction.

Largest All-Welded Aluminum Tank

THE world's largest all-welded aluminum tank, fabricated by the oxy-acetylene process, is used for the storage of chemical products. The tank is 35 ft. in diameter and 20 ft. high. It has a capacity of 160,000 gal. and is designed for service at atmospheric pressure. Despite its size, however, the tank is not reinforced, either internally or externally, by bracing.

The entire job was assembled in the field from plates rolled to shape and already veed and prepared for welding in the shop. Sheet thicknesses ranged from 1/4 in. to 9/16 in., the heavier sheets being used at the bottom and the lighter sheets at the top.

The method of assembly was as follows: After the bottom of the tank was assembled and welded, the bottom ring of vertical sheets was tack-welded in position and then welded. The same procedure was followed for the middle and top rings of vertical sheets.

A timber falsework was built inside the tank to support the top dome segments during assembly. Three segments at a time were tack-welded and then hoisted into place and welded. After the erection of the roof the falsework was removed.

Two welding operators completed the job in 36 days, two days being lost because of inclement weather. In the 544 operator-hours, an estimated total of 995 ft. of tank seam was welded. This was distributed as follows:

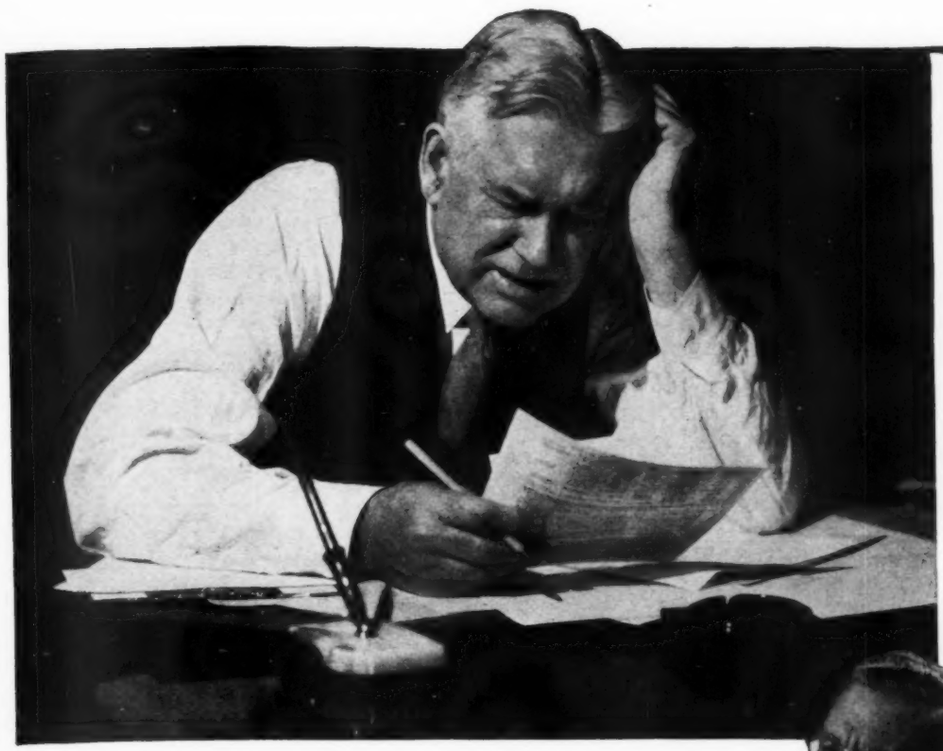
Main tank girth seams	660 ft.
Vertical seams	75 ft.
Top segment seams	168 ft.
Crown sheet seam	31 ft.
Bottom plates	61 ft.
Total	995 ft.

Approximately 43 ft. for nozzles and connections should be added, bringing the total amount of welded seam to 1038 feet. Inasmuch as the welding operators worked a total of 544 hr. on the job, an average of 1.91 ft. of seam was completed per operator-hour. This is an excellent showing particularly in view of the fact that the 544 hr. represents the total duration of the job including all assembling, hoisting, lining-up, and tack-welding.

After erection, the tank was tested, and the welded joints proved satisfactory in every respect.

This all-welded aluminum tank is the largest ever constructed

YOU NAME THE CONDITIONS



Low Carbon
Copper Steel
U·S·S Cor-Ten
½% Moly.
1% Moly.
1½% Sil. ½ Moly.
Nickel Steel
S. A. E. 2315
S. A. E. 6120
1¼% Cr. ½ Moly.
Bain Alloy
2% Cr. ½ Moly.
2½% Cr. ½ Moly.
3% Cr. 1% Moly.
5% Cr. ½ Moly.
5% Cr. ½ Mo. Stabilized
1% Cr. ½ Moly. 1¼ Sil.
2% Cr. ½ Moly. 1¼ Sil.
3% Cr. ½ Moly. 1¼ Sil.
5% Cr. ½ Moly. 1½ Sil.
2¼% Cr. 1% Moly.
U·S·S 18-8
U·S·S 18-8 Stabilized

. . . *and we'll name the TUBE!*

THAT'S what we mean by "Complete Tube Service."

Sounds easy—and it *is* easy—for men who know both steels and refinery operating conditions. Such men are NATIONAL'S Still Tube Specialists. Their job is to be always "in the know" on all questions involving refinery tubes. They can help you, as they have helped major refiners in all parts of the country, to get the most service for your tube dollar.

To give these men the means to help you with virtually any problem involving refinery tubing, NATIONAL has developed the widest available assortment of alloys—24 in all. Each has properties differing from the others. Each functions most economically under certain known specific conditions. One of the 24 may be the means for bringing you worthwhile savings, both in lowering tube replacement costs, and in minimizing lost time due to plant outages.

So call in a NATIONAL Still Tube Specialist next time tube installation or replacement comes up for consideration. You can rely on his recommendations, because he has absolutely no interest in promoting any one alloy over any other. His sole interest is in giving you the most economical tubes for your refinery applications. You name the conditions . . . and we'll name the tube!

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

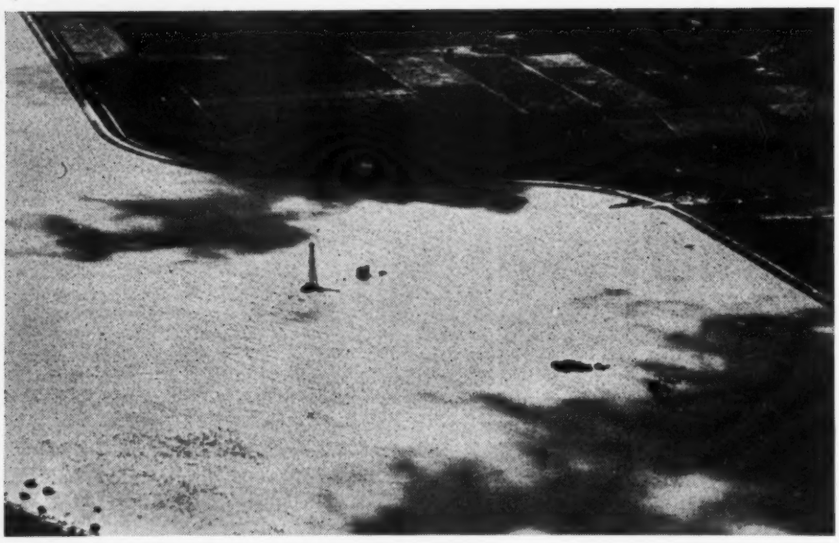
UNITED STATES STEEL

Rio Grande Flood Necessitates Shut-down

By BRAD SMITH

AT low water, the Rio Grande, the boundary between the United States and Mexico, almost "runs dry." (Fig. 1). When the river is on a rampage, the lowlands along its banks and the $6,000,000 government-built floodways are not the best places in the world in which to be drilling an oil well. The floodways carry overflow water between dikes for 85 miles through the rich Lower Rio Grande Valley, but the floodways in eastern Hidalgo County are also a part of the Mercedes oil field.

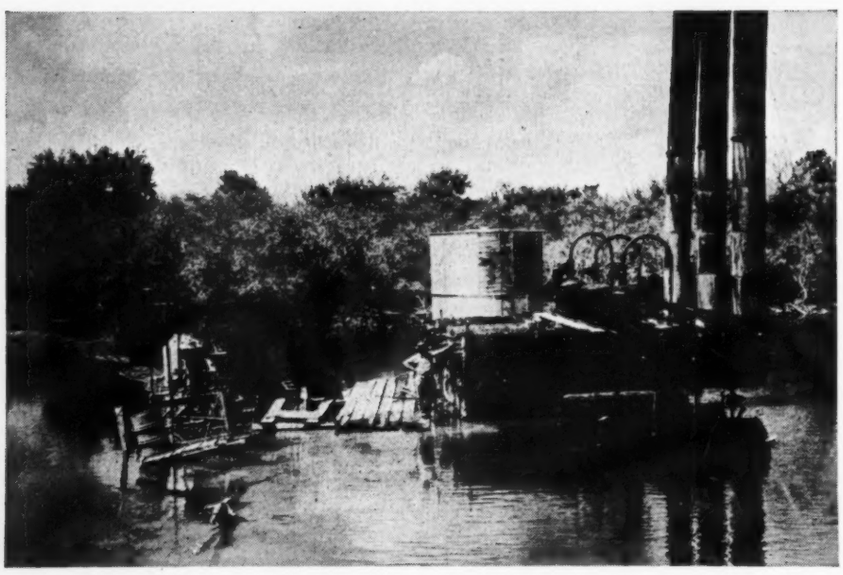
Fig. 1



Thus it was that flood-time on the Rio Grande caught Union Sulphur Company, developers of the 7500-ft. Mercedes field, making a production test in their No. 11 American-Rio Grande. When the water rose in the floodway, the operators set everything movable on the pipe-racks and shut-down. Fig. 2 is an aerial view showing the derrick surrounded by water for a quarter-mile in every direction. The five post-like objects at the right side of the derrick are smokestacks of the five boilers.

The lowlands were not a very good place in which to drill a well in flood-time, either. Henshaw Brothers, San Antonio, Texas, drilling contractors,

Fig. 2



were working on Magnolia Petroleum Company's No. 1 Temple Lumber Company, a 7500-ft. wildcat less than a mile north of the river and south of the city of Donna in southern Hidalgo County. On three different occasions in three months drillers were forced to shut-down and abandon the rig because of high water.

After three weeks of the third shut-down the rig-owners grew curious about the rig. To reach the rig it was necessary to cross almost two miles of water ranging in depth from a few inches to 12 feet.

Everything was intact, but the water had been almost two feet deeper than shown (Fig. 3), as is indicated by the white marks on the boiler fire-box.

Fig. 3

Check these IMPORTANT ECONOMICAL FEATURES

EXCELLAY Preformed Rotary Lines offer them all:

Added resistance to

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√ *BENDING STRESSES*
√ *WHIPPING*
√ *KINKS*
√ *ROTATION ON SHEAVES*

. . . and

√ *EASE AND SAFETY IN HANDLING*
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UNITED STATES STEEL

Fabricating Oil-Well Drilling Bits

Bit material specifications are rigid, and even though each bit is a composite of several alloys, it must be sound and tough enough to withstand severe stress and shock while drilling. The accompanying illustrations tell the story of how a bit used in rotary drilling is fabricated using an oxy-acetylene flame.

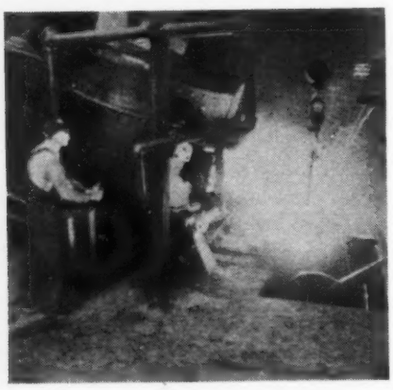


Fig. 1

Bits are made from tough alloy steels. The steel, which usually contains chromium, manganese, molybdenum or vanadium, and silicon, is made in an electric furnace. Fig. 1 shows steel being poured from the furnace.

The necessary machining is done, and high spots on the wings are ground off. In this shop (Fig. 2), a flexible shaft grinder is used to make grooves in the reaming edges to hold the wear-resistant cast tungsten carbide inserts.

After cleaning and preliminary grinding, the cutting blowpipe is often used for trimming and squaring the cutting and reaming edges. Fig. 3 shows the hard-facing and hard-setting materials on hand for the next operation.

When the bit is correctly shaped, cast tungsten carbide inserts are placed in their approximate positions on one wing (Fig. 4), and the blade and inserts are brought to a full red heat with the welding flame before the inserts are set.

An insert is then picked up with the high-strength steel tying-in rod. The heat of the flame is directed at the spot in which the insert is to be set, so as to assure full melting of the steel in that area during hard-setting. (Fig. 5.)

Each insert is buried in the molten metal individually. When all the inserts have been placed and bonded thoroughly, tying-in rod is added to cover each insert completely with a thin layer of high-strength steel. (Fig. 6.)

Fig. 7 shows the outline of the tungsten carbide inserts on the face of the blade. The inserts are set back a little from the cutting edge to allow for sharpening. The bit is now ready for the hard-facing operations.

Fig. 2

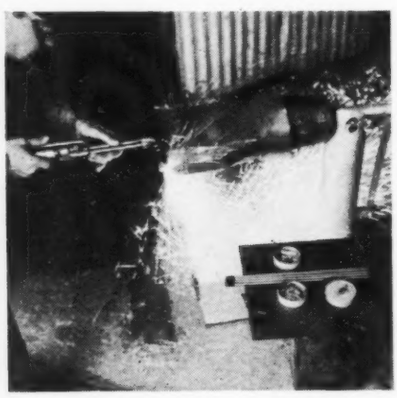


Fig. 3

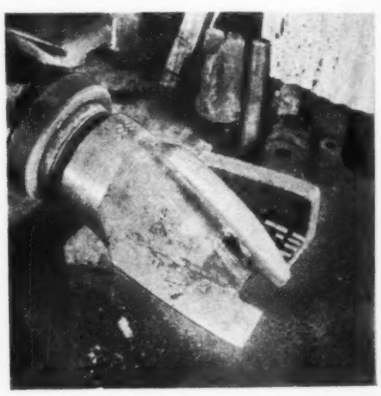


Fig. 4

Fig. 5

Fig. 6

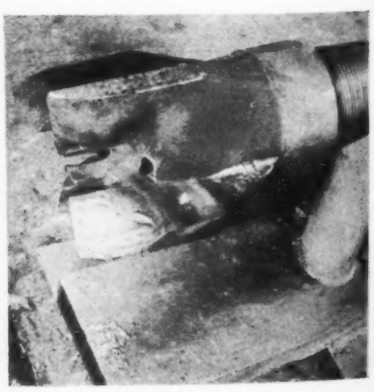


Fig. 7

Fig. 8

Composite rods or tube rods—strong steel tubes containing crushed and screened tungsten carbide particles—are used for hard-facing. The entire area over the inserts is covered with this material. (Fig. 8.)

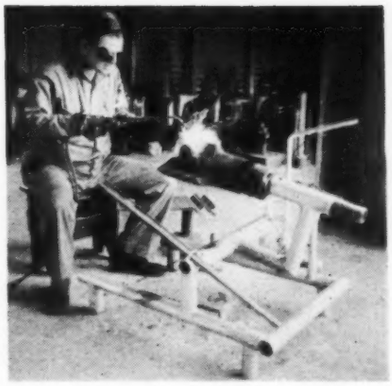


Fig. 9

Hard-setting and facing the cutting edges impart long drilling life. Fig. 9 shows the reaming edges being hard-faced so that the bit will drill a full-size hole. After the bit has been ground sharp, it will be ready for use.

Fig. 10

The bit shown in Fig. 10 drilled 925 ft. of sandy shale at Lomita, California. Observe the excellent fingered condition produced by the wear resistance of the tungsten carbide inserts imbedded in the steel. The bit is still out-to-gauge.

Wyoming Black Oils Studied by Bureau of Mines

BEFORE black oils can command a more favorable position in the markets of the Rocky Mountain region, their characteristics must be better known and methods suitable for refining crude oil of this type must be developed, states the U. S. Bureau of Mines in a recent report on a chemical and refining study of some Wyoming black oils.

The report states further that Wyoming has an estimated potential daily production of about 56,000 bbl. of black oil, although the average daily production during 1937 was only 13,000 barrels. These crude oils are characterized by large sulphur and asphalt contents and small gasoline content and are called black oils for this reason and because of their color. It usually is difficult to refine them into motor fuels, lubricants, and intermediate products such as burning oils. As a consequence, only enough crude oil is produced to satisfy the road-oil and asphalt requirements of the local market.

Because of these circumstances, the Petroleum Experiment Station of the Bureau of Mines, Laramie, Wyoming, has been conducting studies of these black oils, and a progress report has been prepared to give the results of the thermo-decomposition studies to the present. The authors include data on the yields and characteristics of products obtained by cracking Oregon Basin, Dallas-Derby, and Garland topped crude oils to dry coke (non-residuum method) in a batch-type still at different pressures and temperatures. They also give results of chemical treatment and the octane numbers of some light distillates that are suitable for the manufacture of motor fuel.

The straight-run naphtha obtained by atmospheric distillation of the crude oil has a relatively large sulphur content and low octane rating, and it is deficient in low-boiling material. The sulphur content was reduced to present tolerances by treating with sulphuric acid. The acid treatment had a beneficial effect on the over-all characteristics of the naphtha and its octane number.

Thermo-decomposition of the topped crude oils produced a satisfactory yield of cracked naphtha, but the naphtha had an exceedingly large sulphur content, which made necessary drastic chemical treatment to reduce the sulphur to present commercial requirements. Sulphuric acid treatment reduced the sulphur content but also caused a considerable loss in octane rating. Low-temperature acid treatment gave more satisfactory results than treatment at atmospheric temperature.

Approximately one-third of the sulphur in the crude oil was converted to hydrogen sulphide and was produced with the cracked gases during the thermo-decomposition process. About one-third to one-half the sulphur in the crude oil was retained in the coke.

Change of pressure and temperature for the different thermo-decomposition experiments caused change in the yield of products. Increasing the temperature and pressure decreased the yield of cracked distillate and increased the yields of cracked naphtha, adsorption gasoline, gas, and coke.

Although yields of products varied with operating conditions, the sulphur content of the products showed little change throughout the range of conditions that have been studied.

Copies of Report of Investigations 3423, Chemical and Refining Study of Some Wyoming Black Oils, by H. M. Thorne and Walter Murphy, may be obtained upon request, without charge, from the Information Division, Bureau of Mines, Washington, D. C.

2 YEARS at 2600

8 CLARK "Super-2-Angles" at Continental Tepetate Plant. Units are arranged in a double row, back to back

to 3500 POUNDS

At Tepetate—CLARK "Angles" prove they've "got what it takes" for Pressure Maintenance at highest pressures

Two years ago, the Continental Oil Company began operating the World's highest pressure plant for gas conservation and pressure maintenance — in the Tepetate Field of Louisiana.

The plant was equipped with four CLARK 300 H.P. "Super-2-Angle" Compressors, which were capable of returning to the formation 10,000,000 cu. ft. of gas per day, at pressures up to 4,000 pounds. In fact, these units have been operated with entire satisfaction,—on a test,—up to 4,600 pounds. Prior to that time no attempt had been made to return gas to a producing zone at above 3,000 pounds.

During their two years of continuous operation at pressures ranging from 2,600 to 3,500 pounds, the four CLARK "Angles" have given highly satisfactory service. As a result of their excellent performance, two more 300 H.P. units were soon added to increase the capacity of the plant; and recently a further addition of two 5-cylinder 500 H.P. CLARK "Angles" was made. The plant now contains 8 CLARK "Angle" machines, totaling 2,800 H.P.

The Continental Oil Company is probably the outstanding pioneer in pressure maintenance. It is estimated that Pressure Maintenance, at Tepetate, will increase the ultimate oil recovery of the pool by at least 40%. The plant investment required to accomplish this increase is estimated to represent only 5% of the value of the added production.

Write us for booklet giving the history of Pressure Maintenance and its results to date, and the outstanding record of CLARK Compressors in this pioneer field.

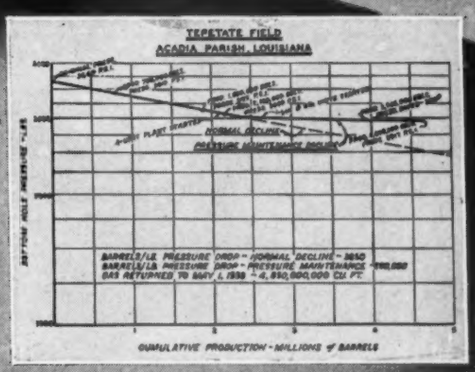
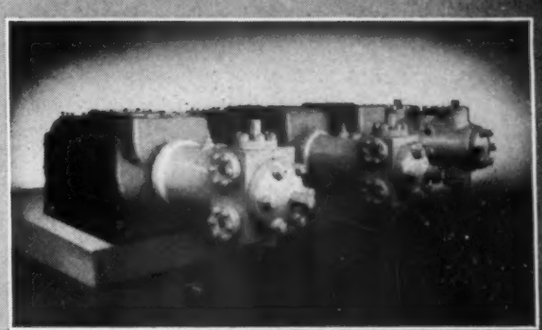
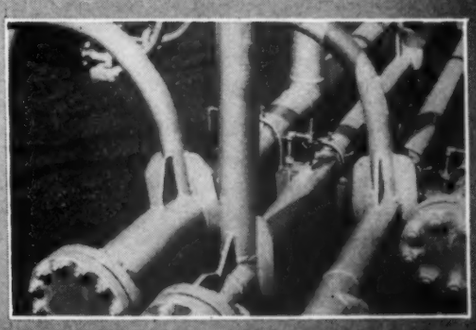


Chart shows how graph of normal decline in pressure "flattened out", when Pressure Maintenance plant was placed in operation



CLARK high-pressure cylinder used for second stage of compression. Barrel and head are forged from single steel billet



Note, above, the weld-reinforcing with gusset plates, for handling the pressures from 2,600 to 4,600 pounds

CLARK BROS. CO. . . . Olean, N. Y., U. S. A.

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CLARK

Reservoir, skimmer, and pump intake, Fitts salt water disposal system

By
J. C. ALBRIGHT

Salt Water Disposal System In the Fitts Pool

Operators' coöperative association pumps oilfield brine into Wilcox and Oil Creek sands after filtering

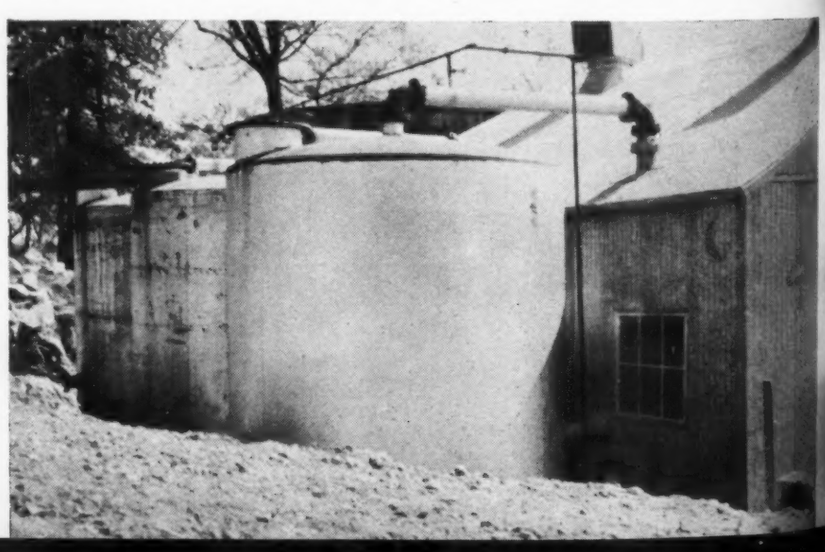
IN the Fitts pool, in T-2-N, R-6-E, and T-2-N, R-7-E, Pontotoc County, Oklahoma, the quantity of salt water produced from some formations rapidly exceeded expectations, and caused concern among the producing companies. The operators naturally expected to lift some water with the oil, but disposal facilities became almost choked in the summer of 1937, and this stimulated an investigation of the possibility of devising a permanent method of disposing of the salt water.

An association was formed by the following companies: Amerada Petroleum Corporation; Bishop Oil Company; Burke-Greis Oil Corporation; Carter Oil Company; Continental Oil Company; Deep Rock Oil Corporation; Stanolind Oil and Gas Company; Sinclair-Prairie Oil Company; Skelly Oil Company; Phillips Petroleum Company, and E. H. Moore, Inc., the last-named company being selected to operate the disposal system. Kenneth R. Teis, chief engineer for E. H. Moore, Inc., and Victor H. Cochran, consulting engineer, Tulsa, were appointed to draw the plans for the disposal system and write the instruction to bidders, form of proposal, form of contract, and specifications of materials used. The name chosen by the association is The Fitts Salt Water Association. It is a mutual coöperative association, the governing committee being selected from the personnel of member companies. Each company assumed a share of the cost of plant construction and disposal of brine in proportion to the number of wells operated and the volume of fluid produced.

The Fitts pool is traversed by several creeks, including Walnut Creek and Mill Creek, which flow into Clear Boggy, all of which carry fresh water suitable for human and animal consumption and for use in boilers, notwithstanding its rather large mineral content. The first salt water produced was collected in large reservoirs and pools and permitted to soak into the soil and to evaporate into the atmosphere. As the volume increased, fear of polluting these streams, and others into which the creeks flow, impelled the operators to develop the disposal system. All the companies were anxious to preserve the purity of the water, and to coöperate with the state fish and game commission in the disposition of oilfield brines and waste oil.

Core analysis of all the formations indicated that water could be pumped into the Wilcox and Oil Creek sands in large quantity if thoroughly filtered. Preliminary investigations indicated that disposal wells on the south side of the producing area would be most successful, but input wells were finally drilled on the north side, where the Wilcox and Oil Creek sands could be reached at a depth considerably less than half the depth to the south. The first disposal well, Waits No. 1, was drilled by the association in NW NW NW 8-2n-7e. Large quantities of water could be pumped into the Wilcox and Oil Creek sands at comparatively low pressure.

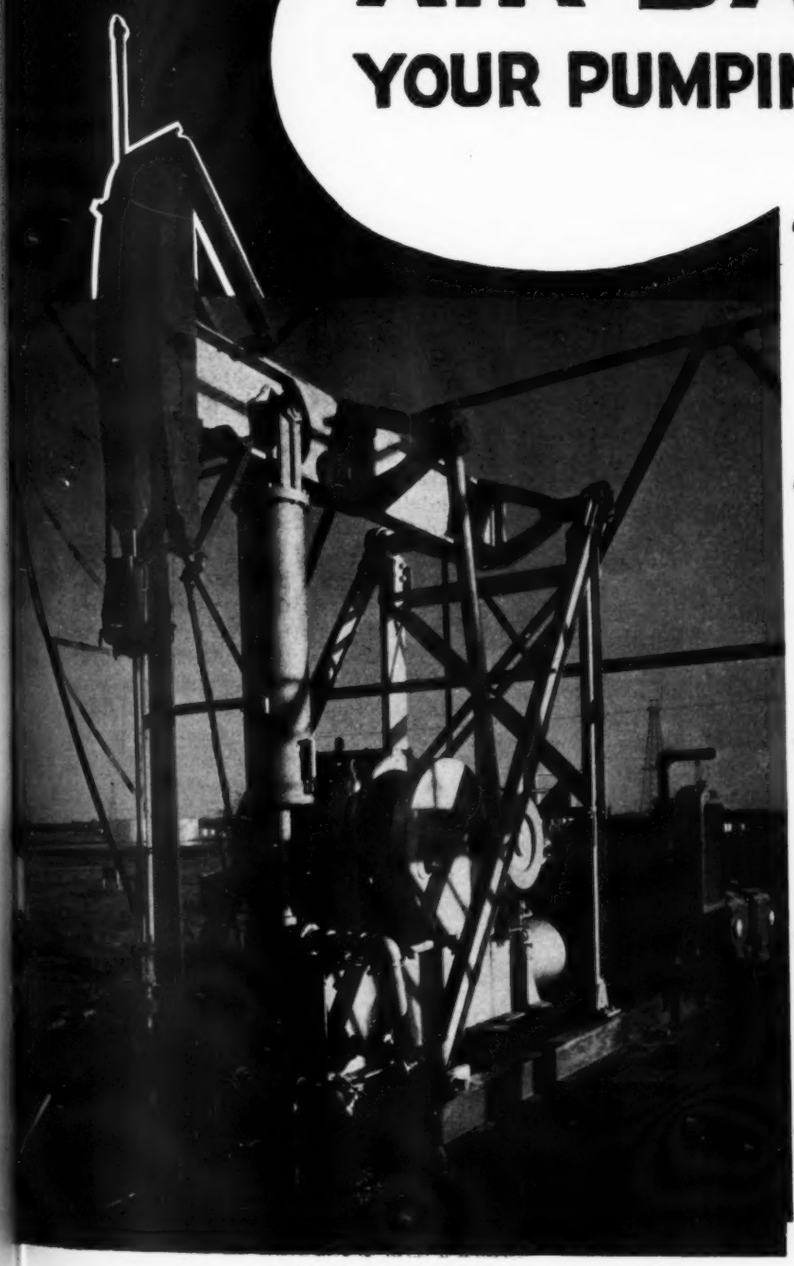
The next problem was the design of a gravity drainage system, main lines, laterals, and feeder lines, to transport the brine to a central reservoir without using booster pumps. Fortunately, the field was developed on both sides of the streams draining the area, and the narrow floodplain of meandering Clear Boggy Creek afforded sufficient fall to permit gravity flow in the main line of the system, which follows the course of the creek to the east end of the area. The receiving reservoir, the filtration



Sand-and-gravel-packed filters

YOU SAVE ON INSTALLATION LABOR PRODUCTION OPERATING COSTS

WHEN YOU AIR BALANCE YOUR PUMPING WELL BECAUSE..



- IT ELIMINATES ALL CUMBERSOME AND INEFFICIENT COUNTER-WEIGHTS

  . . . The REED AIR-BALANCED PUMPING UNIT is less costly to install; requires less foundation.

- ONE MAN CAN SPACE THE RODS, ADJUST THE COUNTERBALANCE, CHANGE STROKE LENGTH, OR SERVICE THE UNIT

  . . . thus materially reducing labor costs.

- IT PUMPS MORE FLUID

  . . . Thus the REED AIR-BALANCED PUMPING UNIT reduces production costs.

- All of these features combine to make the REED AIR-BALANCED PUMPING UNIT the most economical unit to install, service, and operate . . . greatly reducing operating costs.

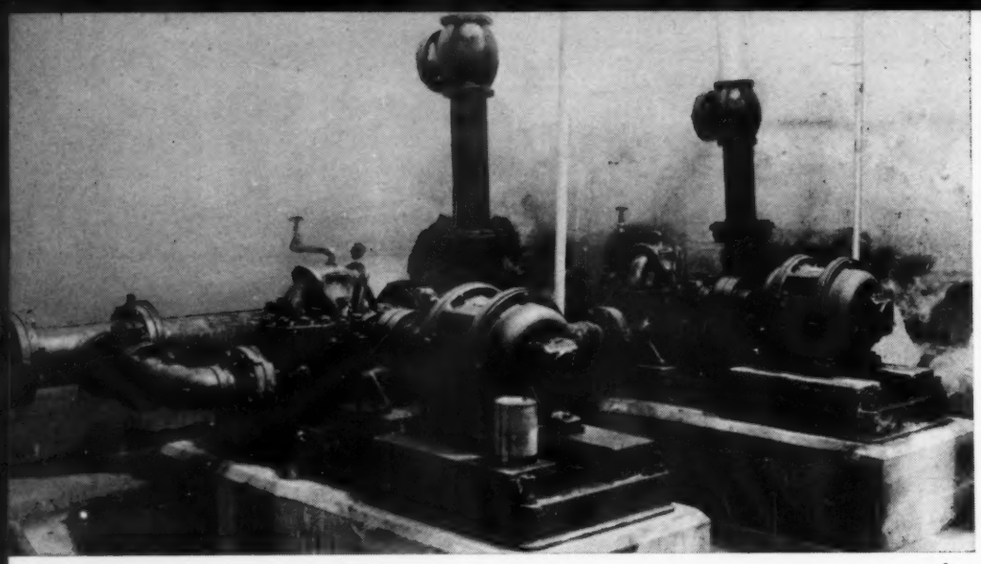
- Over a period of time, the REED AIR-BALANCED PUMPING UNIT is LESS COSTLY than many units that have a lower "first cost."

WHEN YOU CONSIDER THE ULTIMATE COST OF PUMPING YOUR WELL, YOU WILL INSTALL A

REED *Air-Balanced* PUMPING UNIT

REED ROLLER BIT COMPANY

P. O. DRAWER 2119, HOUSTON, TEXAS



Motors and centrifugal pumps to move salt water from the reservoir to the supply tank for filtering

plant, and pump station were built in SW SW 23-2n-7e.

Not all feeder lines and laterals follow the course of the streams, creeks, and branches in the field. Many were directed across water courses, either beneath the ground or on piles or bents. All lines follow the contour of the land in order to obtain the fall required for drainage into the main lines and eventually into the storage reservoir.

From an inspection of the following analysis of the brines it is obvious that plain steel pipe is not suitable for such water systems.

Water Analysis

	Raw water entering plant, grains per gal.	Filtered water at well, grains per gal.
Calcium bicarbonate	4.6	4.4
Calcium chloride	1189.9	1090.5
Magnesium chloride	265.6	298.8
Sodium chloride	7336.1	7262.4
Total alkalinity	4.6	4.4
Total hardness	1460.1	1393.7
Total iron	0.47	0.47
pH	6.5	6.5

Three different types of piping were selected. The type comprising the largest number of lineal feet was salt-glazed vitrified tile. The total amount of tile, as of September 19th, was 122,700 ft. of 4-in. to 12-in. sizes, of which 67,800 ft. was 4-in. and 19,800 ft. was 8-in. tile. To transport filtered brine from the pump station and storage reservoir to the disposal wells north of the field, 28,000 ft. of 6-in. Duroline pipe was used. The rest of the system consists of 14,700 lineal ft. of transite pipe in sizes ranging from 4 to 12 in. inclusive, including 5070 ft. of 4-in. and 4600 ft. of 8-inch.

The Duroline pipe consists of 6⅝-in. O.D., 12.89-lb. seamless steel pipe 0.1875 in. thick and a lining 5/16 in. thick, the weight of the finished pipe being 18.80 lb. per foot. It is plain-end pipe coupled by Rolagrip couplings.

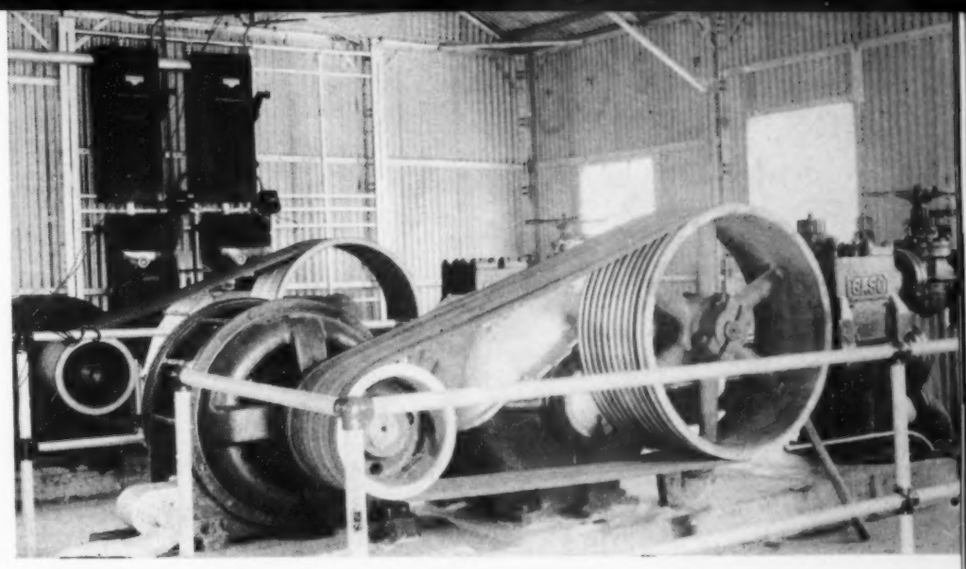
The salt-glazed vitrified sewer tile was used where the ground was comparatively smooth and where no appreciable pressure would be applied. It was the ordinary bell-and-spigot type pipe, and jute and asphalt, or other jointing material, was used to produce water-tight joints.

Transite pipe was used for all stream crossings. Vitrified tile carries the water to the bank of the creek or stream, where the tile is joined to transite pipe by bell-and-spigot sections, oversize collars, regulation manholes like those used in sewage disposal systems, or inverted siphons. If the pipe is not subjected to damage by large, swift bodies of water carrying debris and drift wood, the transite pipe is supported on precast concrete bents capped by bent heads precast as pipe cradling. The bents were set approximately three ft. into the soil, and grouted in hard rock to a depth sufficient to prevent vibration. The pipe line did not necessarily follow a straight line, but was routed to afford gravity flow of the water. The precast concrete bents were set at the proper angle to provide sufficient stiffness for carrying the pipe without lateral movement. The heads, made to fit snugly over the upper ends of the bents, were precast to provide saddles to fit pipe of a particular size, but large enough that leveling and supporting grout might be poured or troweled between the pipe collars and the cradles. A hole in the center of each cradle permitted grout to flow to the top of the bent to form what might be termed a monolithic structure.

At a crossing of the inverted-syphon type, junction boxes or manholes approximately four ft. square were constructed, the height varying according to the depth of the valley. The spigot end of the clay tile was inserted into the junction box and grouted in place. On the opposite, or downstream, side of the junction box, transite pipe was inserted at the required angle to conform to grade and was joined to the junction box by concrete.

Stream crossings of two types were used, the choice depending upon whether the stream bed was earth or rock. In each type the pipe leading from the upstream junction box to the crossing was transite. It was joined to a cast-iron bell-and-spigot bend at the crossing. If the stream bed was earth, the bend was connected to a three-bell cast-iron tee, provided with a blowoff connection, and entirely encased in concrete. Transite pipe was laid across the stream in a ditch of sufficient depth to prevent washing and was covered with tamped earth. The downstream side of the crossing utilized a two-bell cast-iron bend encased in concrete, transite pipe continuing to the downstream junction box. It was cemented in the opening by concrete fill that carried the pipe grade to the entrance of the clay tile on the opposite side of

Closeup of pipe, bents, and pre-cast heads, showing grout between pipe and supports



100-hp. motors driving 5¼-in. by 10-in. pumps

the junction box. The bell end of the tile was placed in the junction box.

If the creek channel was solid rock, the junction boxes were made the same and transite pipe was laid to the channel, where a cast-iron bell-and-spigot bend and a three-bell cast-iron tee were used. The rock was picked or blasted from the creek bed to form the usual type of rock-chipped crossing. A minimum clearance of three in. was allowed between the pipe and the rock walls of the ditch, and the entire pipe was encased in concrete. The downstream end of the crossing at the stream bed was equipped with a two-bell cast-iron bend, also encased in concrete, and transite pipe extended to the junction box, the connections being similar to those used for crossings of streams having earth beds. If the streams were dry for the greater part of the year, the bell-and-spigot connections were made by jute and asphalt joints, but otherwise leaded joints were used. Concrete encasements, whether for the full creek crossing or for cast-iron connections, were poured from a 1:3:5 mix. Three-bell cast-iron tees were fitted with plugs designed to be used for blowoffs if necessary in operating the lines.

Tile drains similar to road crossings were used for crossing minor ditches. The main or lateral lines were covered with earth after they were laid. Similar crossings were made for lease roads. If the depth of cover was less than four ft., the glazed tile was protected by a steel pipe and the fill was covered with a concrete slab about eight in. thick and about four ft. wide, reinforced with ½-in. bars spaced on 6-in. centers. Where the system crossed Highway 48 at Fittstown, 6-in. transite was encased in 10-in. pipe, as at ordinary pipe line crossings.

At the storage reservoir and pumping station site, about 8000 cu. yd. of earth was moved to construct the receiving and storage basin and the various sumps. The main reservoir is 120 ft. by 220 ft., diked with an 8-ft. crown, and lined with concrete on a rolled and tamped surface. The concrete sides extend five ft. up the wall, and rock rip-rap extends to the top. The main gathering system terminates in a junction box outside the reservoir. It is connected through 12-in. transite pipe to a skimming basin within the reservoir. The skimming basin is 48 ft. by 48 ft. by 10 ft. high, and in each side has 32 openings one ft. square, spaced equi-distant from each other, through which water flows from the basin to the reservoir after the oil rises to the surface. The oil is skimmed as necessary and is trucked to the various leases and used to surface roadways, but, as the water is carefully drained from tank batteries in the field, very little oil has been available for road building.

Centrifugal pumps are used to lift the raw reservoir water to the filtration plant. They are situated in a concrete shaft at the level necessary for flooded suction. They take suction through a 10-in. transite pipe, 50 ft. long, attached to an intake box near one end of the reservoir. Water is discharged into a 1000-bbl. redwood tank, placed on a hill behind the station at sufficient elevation to provide gravity flow through the filtration plant.

Two 2½-in. single-stage centrifugal pumps lift the brine from the skimmer at the reservoir. Each pump has a capacity of 7500 bbl. of brine per day against a head of 60 ft., and is constructed entirely of bronze except the shaft, which is stainless steel. The pumps are driven by 7½-hp., 440-volt, 3-phase motors mounted on the same base. A third pump will be installed soon.

The filtration plant consists of three steel tanks, 8 ft. by 9 ft., in which gravel and sand of the usual type are placed. The vessels are manifolded to facilitate back-washing to remove sediment accumulating on the filter. The brine flows to a 1000-bbl. redwood pump station supply tank, from which the reciprocating pipe-line pumps, driven by 100-hp. electric motors, transport it to the disposal wells, approximately 5.3 miles from the pump station.

The brine is pumped to the wells by two 7-in. by 10-in. pumps equipped with 5¼-in. by 10-in. liners to provide a maximum discharge pressure of 700 lb. per sq. inch. The piston rods are stainless steel and the stuffing boxes, pistons, wing-guided valves, and valve seats are bronze. The fluid ends and liners are cast molybdenum iron alloy. Each pump is driven at a speed of 60 s.p.m. by a 100-hp., 440-volt motor through a V-belt drive.

The actual discharge pressure is about 425 lb. and the well input pressure is about 230 lb. when the input rate is 585 bbl. per hour.

Three wells were specially drilled for brine disposal. The Wilcox sand was reached at an average depth of 1667 feet. The Oil Creek sand was reached at an average depth of 1865 feet. Each well was cased and cemented to surface. In the first two wells drilled, 7-in. O. D., 24-lb. standard seamless pipe was set on top of the Wilcox. The last well was cased with 7-in. O. D., 22-lb. standard seamless pipe, which also was set on top of the Wilcox sand and cemented. The average amount of open hole in these wells is 670 ft., all formations between the bottom of the string of pipe and the Arbuckle lime being exposed to the salt water.

At a pressure of about 250 lb., 11,000 bbl. of brine per day is pumped into the sands and shales. Since the project has been completed no pressure build-up has been noticed, showing that filtration has clarified the water sufficiently that the sand face is not plugged to any noticeable extent. If there should be any noticeable increase in pump pressure, indicating plugging of the sand, some type of treating system that will remove the iron from the water will be installed, as provisions were made for it in the design of the filtration plant.

As this system serves only properties operated by the member companies, it does not dispose of all the salt water produced in the Fitts pool. The Magnolia Petroleum Company is constructing a similar system, but will utilize a disposal well drilled on the south side of the pool. When the system is completed and placed in operation, no salt water will be noticeable on any property in the Fitts Pool, and all creeks and rivers will be free from pollution.

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1. Use lighter weight for specified depth and maintain the present safety factor—at less cost.
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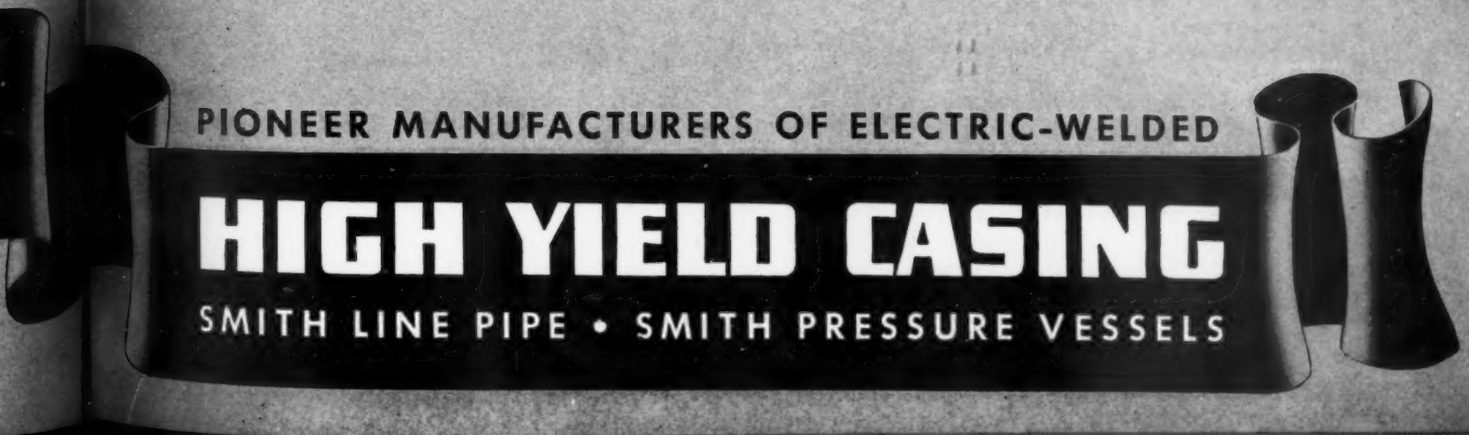
*Because of greater compression strength, you get greater resistance to "pull-out."

*Because threads are more accurate, you get—

1. Greater make-up speed.
2. Greater running speed.



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Hunt Oil Company and Landrum No. 13 W. R. Moore, one of the wells being flowed by gas-lift

Gas that would otherwise be virtually valueless is made to produce oil economically. Flow valves are an important feature

Gas-Lift Project in East Texas Field Utilizes Gas From Distillate Well

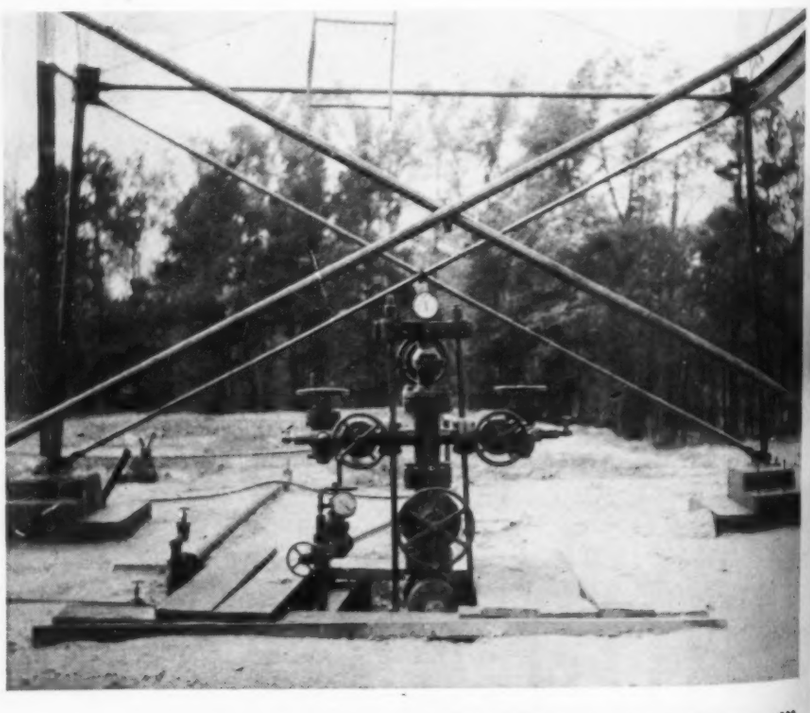
By JOHN W. LEE, Gas Division, Hunt Companies

as told to

FRANK H. LOVE

AN extensive gas-lift program utilizing gas from a recently completed high-pressure discovery well has been instituted in the East Texas field by the Hunt Oil Company. At the time of writing 13 of the company's wells that had ceased flowing naturally had been placed on gas-lift and others were to be added as artificial lifting methods became necessary. In addition, officials of the Hunt organization state their plans include the selling of gas to other firms in the field for gas-lift purposes at a cost of 11 cents per 1000 cu. feet.

Completion of Hunt Oil Company's wildcat No. 1 Bradley, in the Chapel Hill area eight miles east of Tyler, Texas, as a high-pressure gas-distillate well led to the decision to lay a line to company property near Wright City in the south end of the field for gas-lift purposes. This decision served to solve a twofold problem by providing an outlet for production from a wildcat well that otherwise might have been a burden to the operator, as conservation laws require that some use-



No. 1 Bradley, the source of the gas supply

EVIDENCE . . .

Reprint from
THE PETROLEUM ENGINEER
December, 1938

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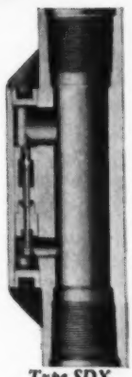
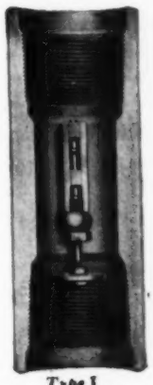
As a part of the project a pipe line was laid designed to carry the highest operating pressure of any gas line in the Mid-Continent used entirely as a transportation medium. From Bradley No. 1, which has a well pressure of 2770 lb., the line extends to a point immediately north of Overton, then turns southward and terminates at the Hunt Oil Company's "A" lease near Wright City. Seamless pipe was used throughout, eight miles being 6⅝-in. in diameter and eight miles 5-in. pipe. Laterals were 4-in. and 5-in. pipe and lead lines 2½-in. pipe. Additional 5-in. pipe is now enroute from the mill for the enlargement of the system, which will be extended northward from Overton. . . .

The line pressure of 1000 lb. is reduced to 350 lb. at the injection well by Grove high-pressure regulators. Gas is injected into the annular space between the tubing and casing. It was determined in this instance that no special arrangements were needed at the wellhead for injection of gas into the annular space other than first testing the casinghead connections to make sure that they could withstand a pressure of 500 pounds.



Type SDX
Full Opening



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The success of Gas Lift operations is dependent on a careful analysis of both well and lease conditions. Therefore, we have a staff of trained engineers who are thoroughly equipped to solve your producing problems, including a complete bottom hole pressure service. Avail yourself of this service. Reduce your lifting costs —Increase your profits!

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• The Gas Lift office and shops at Kilgore are within thirty minutes of any part of the East Texas field. Prompt and dependable service is insured, twenty-four hours every day. This service branch is typical of those operated by Gas Lift in all areas.

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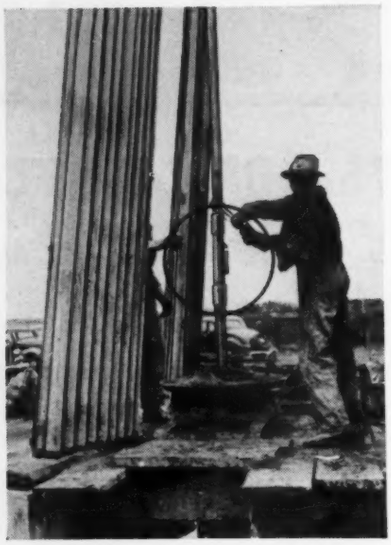


Valves are installed outside of the tubing, allowing full opening through the inside of the tubing

ful disposition of gas be made before the distillate produced with it can be utilized; and providing an economical method of producing oil wells in the area by gas-lifting.

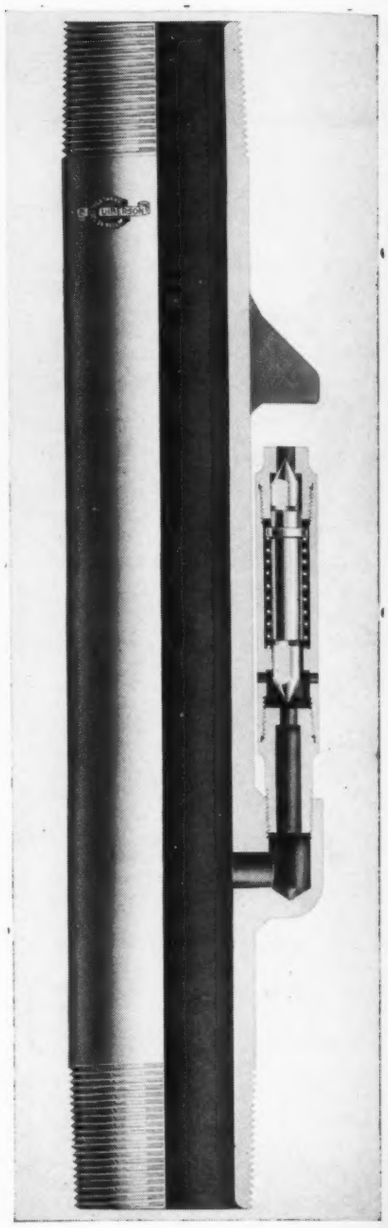
As a part of the project a pipe line was laid designed to carry the highest operating pressure of any gas line in the Mid-Continent used entirely as a transportation medium. From Bradley No. 1, which has a well pressure of 2770 lb., the line extends to a point immediately north of Overton, then turns southward and terminates at the Hunt Oil Company's "A" lease near Wright City. Seamless pipe was used throughout, eight miles being 6⅝-in. in diameter and eight miles 5-in. pipe. Laterals were 4-in. and 5-in. pipe and lead lines 2½-in. pipe. Additional 5-in. pipe is now enroute from the mill for the enlargement of the system, which will be extended northward from Overton.

As the line is designed for a working pressure of 1200 lb. it was recognized that in the construction of the system the utmost in engineering ingenuity would be required to assure efficient and safe operation. For this reason specifications were rigid and workmen were required to conform to high standards of ability and workmanship. The Wood Engineering Construction Company, Arp, Texas, was the general contractor on the job, and the welding method adopted was the oxy-acetylene process known as Airco welding. Engineering assistance was provided by the Applied Engineering Department of the Air Reduction Sales Company, which renders a service to assist in procuring qualified welders, in inspecting welds, and in helping the construction foremen and welding operators in the correction of welding faults.

When completed the line was tested at 1000-lb. shut-in pressure for a period of 24 hours and only two small pinholes were found.

Gas produced by the Chapel Hill well is separated from the distillate and metered before entering the pipe line. The arrangement of this meter setting is somewhat unusual. As can be seen in an accompanying illustration, the piping is provided with a 90-deg. tube-turn instead of the customary 45-deg. bend and the plug valves at each end are placed near the ground. This setup obviates the possibility of the line, because of the high pressure, rearing and breaking below the valves when orifice plates are being changed.

The line pressure of 1000 lb. is reduced to 350 lb. at the injection well by Grove high-pressure regulators. Gas



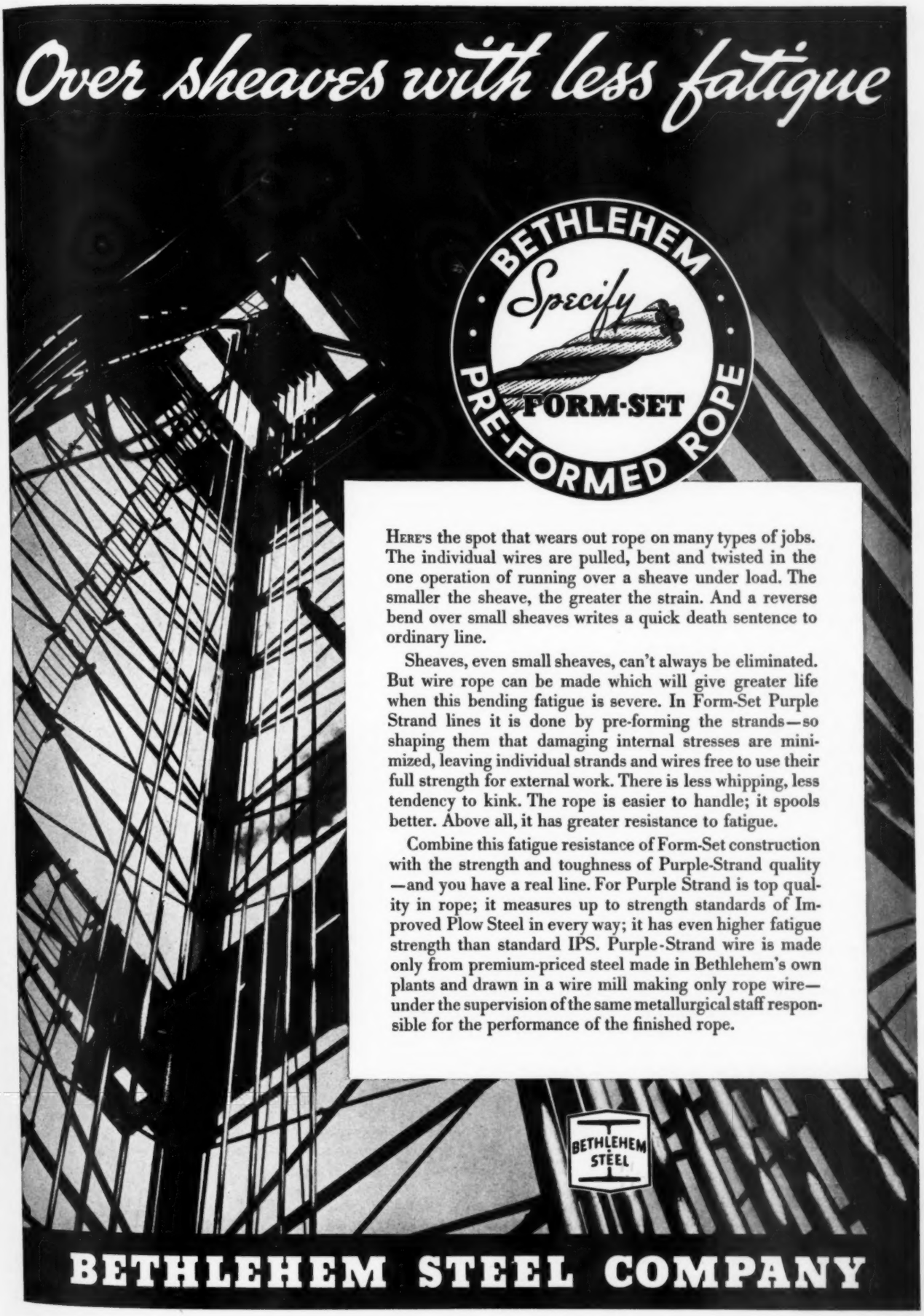
Cutaway view of Guiberson Corporation's Type C flow valve

is injected into the annular space between the tubing and casing. It was determined in this instance that no special arrangements were needed at the wellhead for injection of gas into the annular space other than first testing the casinghead connections to make sure that they could withstand a pressure of 500 pounds.

Five to eight flow valves are used in each well, set in the tubing string at

Laying the high-pressure gas line

Over sheaves with less fatigue



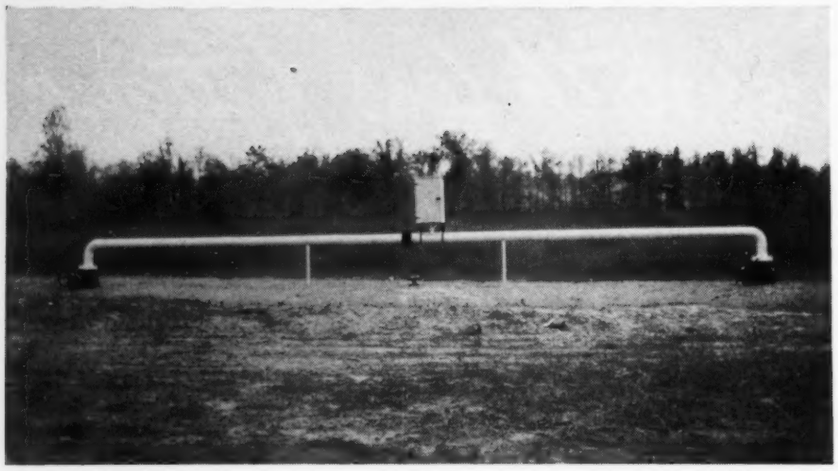
HERE'S the spot that wears out rope on many types of jobs. The individual wires are pulled, bent and twisted in the one operation of running over a sheave under load. The smaller the sheave, the greater the strain. And a reverse bend over small sheaves writes a quick death sentence to ordinary line.

Sheaves, even small sheaves, can't always be eliminated. But wire rope can be made which will give greater life when this bending fatigue is severe. In Form-Set Purple Strand lines it is done by pre-forming the strands—so shaping them that damaging internal stresses are minimized, leaving individual strands and wires free to use their full strength for external work. There is less whipping, less tendency to kink. The rope is easier to handle; it spools better. Above all, it has greater resistance to fatigue.

Combine this fatigue resistance of Form-Set construction with the strength and toughness of Purple-Strand quality—and you have a real line. For Purple Strand is top quality in rope; it measures up to strength standards of Improved Plow Steel in every way; it has even higher fatigue strength than standard IPS. Purple-Strand wire is made only from premium-priced steel made in Bethlehem's own plants and drawn in a wire mill making only rope wire—under the supervision of the same metallurgical staff responsible for the performance of the finished rope.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY



Unusual arrangement of meter setting at No. 1 Bradley

intervals ranging from 200 to 350 ft., the top valve at about the static fluid level. The number of valves to be used and the valve spacing are determined from bottom-hole pressure data and the past history of the well.

Tests show that about 300 cu. ft. of gas is required to lift a bbl. of fluid, and of this volume the amount of gas injected varies according to the quantity of salt water the well is producing. The wells on gas-lift are allowed to flow only a part of each day, until the well's allowable is produced. The prevailing sizes of tubing are 2 in. and 2½ in., and tubing already in the well is utilized. The rate of flow through 2-in. tubing is 20 to 30 bbl. per hour and through 2½-in. tubing 30 to 50 bbl. per hour. The average oil-water ratio has varied from 50 to 60 percent. The average gas-fluid ratio of the well output is about 600 cu. ft. per bbl. Of this amount 300 cu. ft. is formation gas, the other 300 cu. ft. being input gas. A time schedule has been devised whereby only a part of the wells are flowed at a time. Injected gas is measured for a group of wells rather than for individual wells, usually one meter being provided for each lease. Injection of gas into each well is controlled automatically and the average starting and flowing pressures are 350 pounds.

A 2½-in. flow line leads from the well to the trap, and after the gas is separated from the oil it is delivered to a casinghead gasoline plant for extraction of the gasoline. Analyses show the gas accompanying the oil to be rich in gasoline, averaging 4.7 gal. per 1000 cu. ft. of gas. This gas is metered by leases.

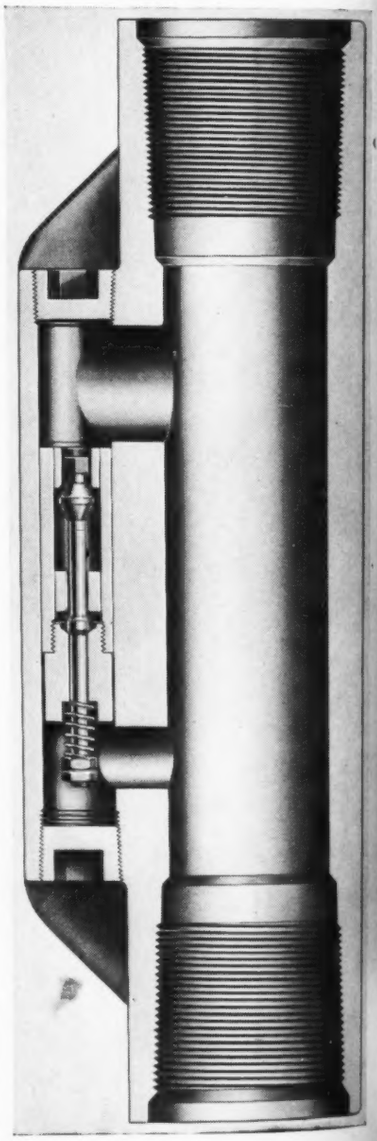
In equipping the wells for gas-lift, the operators installed flow valves of four different manufacturers. Although all are of the spring-loaded differential type they differ in certain particulars.

The Type C flow valve of the Guiberson Corporation is designed to operate on a differential pressure both in opening and closing. The velocity of the gas passing through the valve into the tubing and the flowing velocities in the tubing do not in any way react on the valve. Only the increase and the decrease in pressure in the tubing open and close the ports. For example, at a casing pressure of 350 lb., if the valve has been set to operate at 100-lb. differential, it will open when the pressure exerted by the fluid load in the tubing is 250 pounds. After the valve has opened and admitted gas into the fluid column there will be an increase in pressure in the tubing as the head starts to move. As the head of fluid is removed the pressure will decline correspondingly and when it reaches 250 lb. the valve will close. It should be noted that there is no gas passing lengthwise through the valve mechanism, all the gas entering the ports in the side and going directly into the tubing. The size of the port and the setting of the operating pressures are regulated to conform with the condition of the well.

In the manufacture of this valve Grade "C" K-monel metal and 18-8 stainless steel are used, neither of which is subject to corrosion.

The Bryan Type SDX flow valve, manufactured by the Gas-Lift Corporation, is designed for use as a kick-off or unloading valve, as a combination unloading and reopening flow valve for continuous operation, or as an intermitting valve in wells of low productivity index or low bottom-hole pressure. As this is a differential-pressure-controlled valve, the opening pressure is adjusted so that at any casing pressure each valve will reopen when a certain pressure exists at that point in the tubing where the valve is situated, making possible close calculation of the fluid load necessary for reopening. When a sufficient differential is established across the inlet port after the fluid head is delivered from the tubing the valve is closed by the friction of the injected gas across the enlarged upper element of the valve. If control is desired over a prorated well, as in the East Texas field, so that at reduced casing pressure a quantity of fluid less than the well's capacity can be produced per day, setting of the valve for reopening has decided advantages. By controlling the casing pressure, flow is established at any upper valve at the rate required. Stopcocking

Bryan Type SDX flow valve of Gas Lift Corporation



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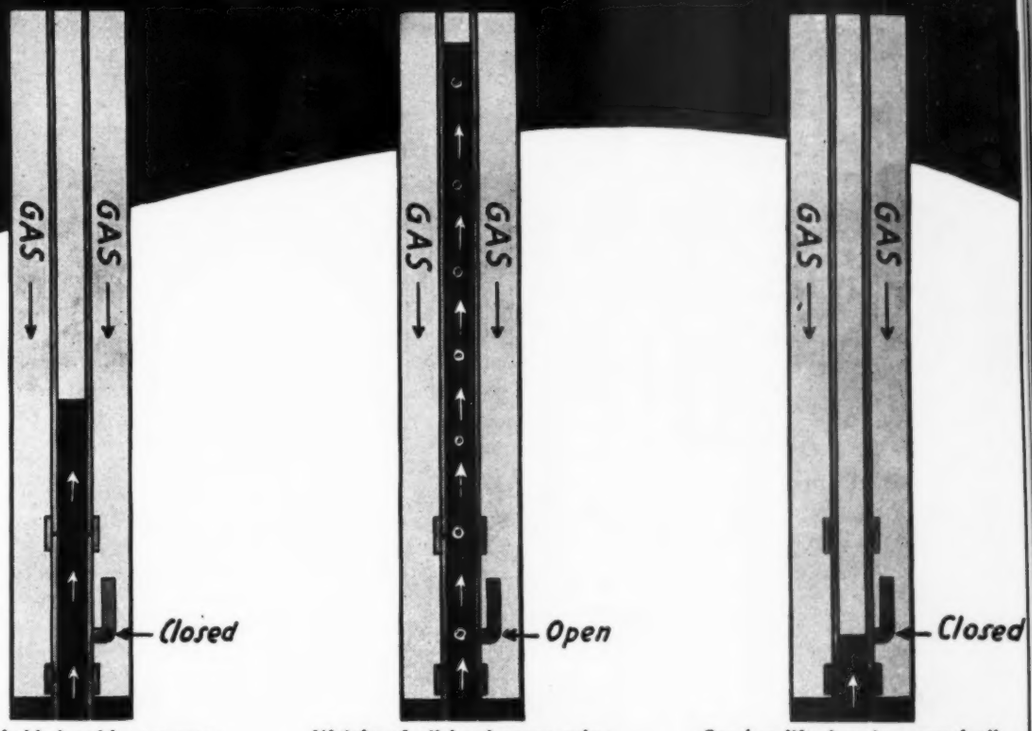
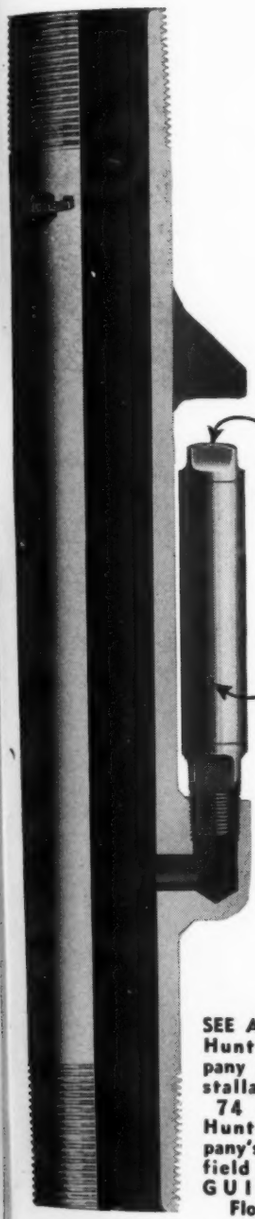
Our record is 100% Perfect, on every gas lift installation of the new type GUIBERSON Flow Valve



Valve is held closed by gas pressure while oil head builds up

Weight of oil head opens valve —Gas is admitted to tubing

Gas has lifted and removed oil head — Valve is again closed while head builds up



SEE ARTICLE on Hunt Oil Company gas-lift installation, Page 74 and ask Hunt Oil Company's East Texas field men about GUIBERSON Flow Valves

—with a Flow Valve operated by differential pressures only, both in opening and in closing

The new type GUIBERSON Flow Valve (patent pending) at last provides the valve that gas-lift men have been awaiting. This is the first valve to be operated solely by differential pressures, both in opening and in closing. Its double-action piston is simple and positive in operation. Velocity of fluid has no effect on it, whatever. It opens only when the head of oil is heavy enough to establish the pre-determined differential, —and it promptly closes after the gas has lifted and removed the head of oil.

The valve is accurately set at factory, on a special test block, for the pressure differential required by the actual well condition, assuring the operator a successful installation on the initial setting, and eliminating guess work.

Our customers have access to our authentic production records (company names omitted), and are invited to use the services of our gas-lift engineers.

Some additional facts and advantages:

1. Only 1 moving part—the valve stem. Is adjusted for different differentials by merely changing spring.
2. So small it installs in smallest casing. Mandrels to fit any size tubing.
3. Full hole opening allowing swab, paraffin scraper or bottom hole bomb to be run.
4. May be used to produce through either tubing or casing.
5. 6 to 8 valves used in average installation.
6. Installations require less than 300 cu. ft. of gas per barrel of fluid raised.

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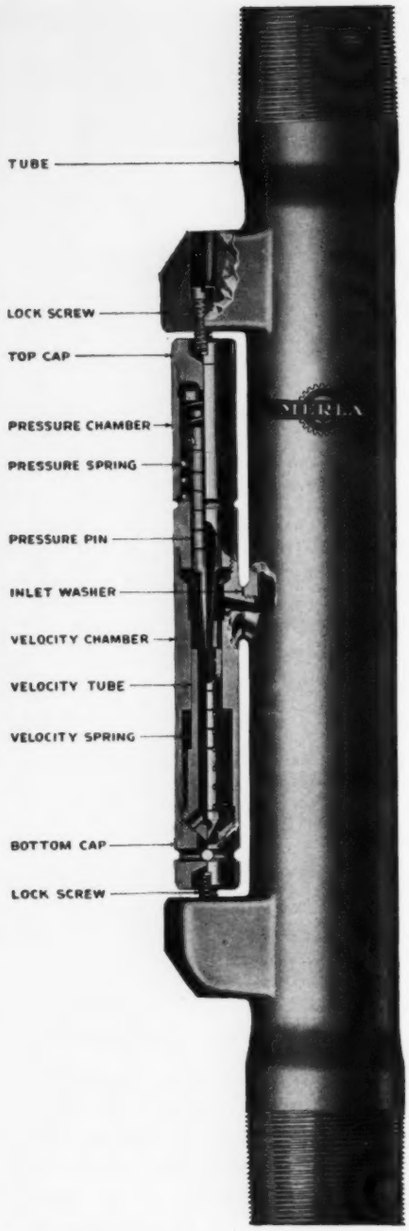

Merla Tool Company's Type A flow valve

is thus eliminated and manual control reduced. As the casing pressure declines the flow continues from a depth commensurate with the power available. When pressures are increased each valve closes successively and flow is continued without the necessity of kicking-off the well by manual means.

The Bryan flow valve is used in the usual type of intermitting well of low productivity index and low bottom-hole pressure and also in many wells having a high productivity index and a low allowable and wells having a low productivity index and a high bottom-hole pressure. The last two intermitting installations differ from the first installation in that they are usually open type systems whereas the first described must necessarily be a closed system.

The Bryan flow valve is automatic in its operation, provides full clearance for bombs, floats, paraffin knives, etc., is of monel-metal construction, has but one moving part, is adjustable over a wide range, and has renewable valve parts.

The Aucoin flow valve, made by the Kyner-Long Corporation, is a spring-balanced valve having a single valve element and seat. The valve opens on differential pressure and closes with the velocity head of the operating fluid (air or gas). Material for the seat and valve stem is carefully selected and heat-treated to meet hardness requirements. Non-corrosive metals are used in the construction of every part of the valve. As consistency under operating conditions is essential, the valve is tested at the factory for opening and closing pressures, and in addition a capacity test is made. The volume of gas passing through the valve is of great importance and control of this volume removes the element of chance. The Aucoin valve has been designed for application to all flowing conditions, intermitting flow, capacity flow, and casing flow.

Merla Tool Company flow valves of two tyes are being used, the Type A and the Type B-7. The Type A valve is adaptable for all general-purpose flow valve installations and in construction embodies the fundamental principles of all valves of this general type. The valve is mounted on a standard tubing pup joint, a mounting that permits exchanging the operating mechanism on various size tubes. The valve has four moving parts, the velocity tube, metering pin, velocity tube spring, and pressure pin spring. The velocity tube is for the passage of the lifting gas to the fluid. The velocity tube spring serves principally to maintain free movement of the velocity tube and is the same in all valves regardless of flowing conditions. The metering pin is the most important element in this valve as it controls the size of the effective gas passage, the differential across the valve, and effects the shut-off of the gas flow. To describe the operation of the metering pin briefly, it automatically varies the size of the gas inlet port in direct ratio to the pressures existing inside and outside the valve. As the pressure in the tubing declines, the pin reduces the size of the gas inlet and therefore the amount of gas admitted. The curve of the pin point is such that the size of the orifice is reduced uniformly and in direct ratio to the travel of the pin into the orifice.

The Type A valve is not efficient for intermittent flow, however, but the Type B-7 was developed to perform such work, and into the valve was also incorporated the mechanism necessary for service under normal flowing conditions. The design of the Type B-7 valve is based upon the Type A in that it is a combined velocity and pressure action mechanism. The metering pin and back-check features are retained; however, the mechanism is somewhat simplified. It has only two moving parts, consisting of one pin and one spring.

Aucoin flow valve of Kyner-Long Corporation

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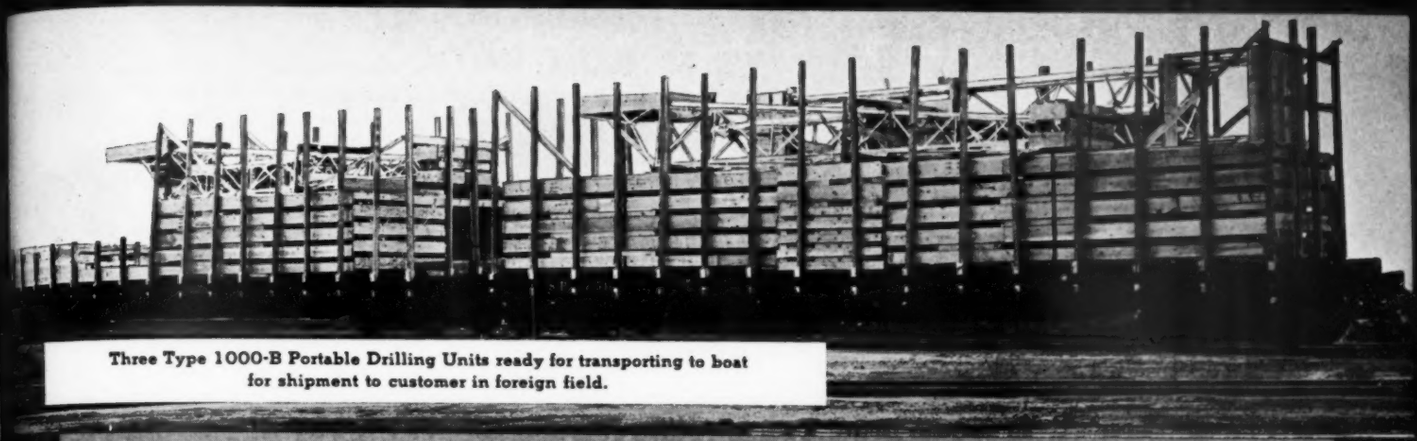

Three Type 1000-B Portable Drilling Units ready for transporting to boat for shipment to customer in foreign field.

- Separate engine for draw works drive and slush pump drive.
- Parallel engine hook-up with provision for emergency drive.
- Mechanical drill pipe feed with 10-foot travel.
- Automatic swivel to drill stem engagement.
- 33-foot derrick of 12-ton capacity.
- Adaptable for mounting on any type conveyance.

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are available in other sizes—the 500-ft. unit for SEISMOGRAPH work, and the 1500-ft. unit for deeper drilling.

The High-Pressure High-Temperature Turbine Electric Steam Ship "J. W. Van Dyke"*

Part 2 (Concluded)

By LESTER M. GOLDSMITH
Chief Engineer, The Atlantic Refining Company

Propulsion Motor

THIS is of the synchronous-induction type with 80 poles and is rated at 5000 s. hp. at 90 r.p.m., 2300 volts, 3-phase, unity power factor.

It is only 17 ft. in diameter by 14 ft. long overall. This length includes the space allowed for sliding the stator aft to clear the rotor in case repairs are necessary. This arrangement avoids any need of disturbing the bearings or shaft alignment, and this is the first time such an arrangement has been used.

The motor is separately cooled, but motor, fan, and air coolers are all enclosed in a tight duct system so as to give practically the effect of a totally enclosed motor.

Both the generator and motor are equipped with CO_2 connections for fire protection.

Control

The photograph (Fig. 11) and diagram (Fig. 9) show the main control panel with the operating levers.

The method of control is extremely simple. The left hand lever (30) as you face the controls has three positions for both ahead and astern. As it is moved from the off position, it first closes the line contacts to the generator, then the generator field contacts so that the motor starts as an induction motor, and finally the motor field contacts, which causes the motor to pull into step and run as a synchronous motor.

Beside this lever is the turbine governor lever (31), which permits varying the speed of the generator from 900 to 3780 r.p.m. by adjustment of the governor setting.

In addition, there is an emergency throttle lever (32), which permits operating the generator on hand control to 75 percent of normal speed and an emergency trip (27).

All these levers are mechanically interlocked to prevent incorrect operation.

Auxiliary Sets

Two of these are fitted, one to run and one stand-by. Each consists of a geared turbine (5568-1200 r.p.m.) driving a 350-kw. 60/50-cycle 450-volt synchronous generator, a 65-kw. 110-volt d-c. exciter for the main units and a 20-kw., 120-volt d-c. generator for excitation of the 350-kw. auxiliary generator and supplying miscellaneous d-c. requirements.

The auxiliary units are so arranged that under normal conditions (60/50 cycles) the 350-kw. unit operates as a motor, taking current from the main generator to drive the d-c. machines and drag the turbine. (No cooling of the turbine is required as vacuum is maintained through a connection to the main condenser.) When the speed of the main generator drops to approximately 52 cycles, the speed governor of the auxiliary set automatically starts to open the steam admission valve so that the auxiliary turbine assumes the full auxiliary load by the time the main unit has slowed to 50 cycles. The circuit-breaker between the two generators opens automatically to prevent the auxiliary generator attempting to motor the main generator. If the auxiliary turbine is to operate

*Paper read before American Society of Mechanical Engineers at the annual meeting in New York, December 5, 1938.

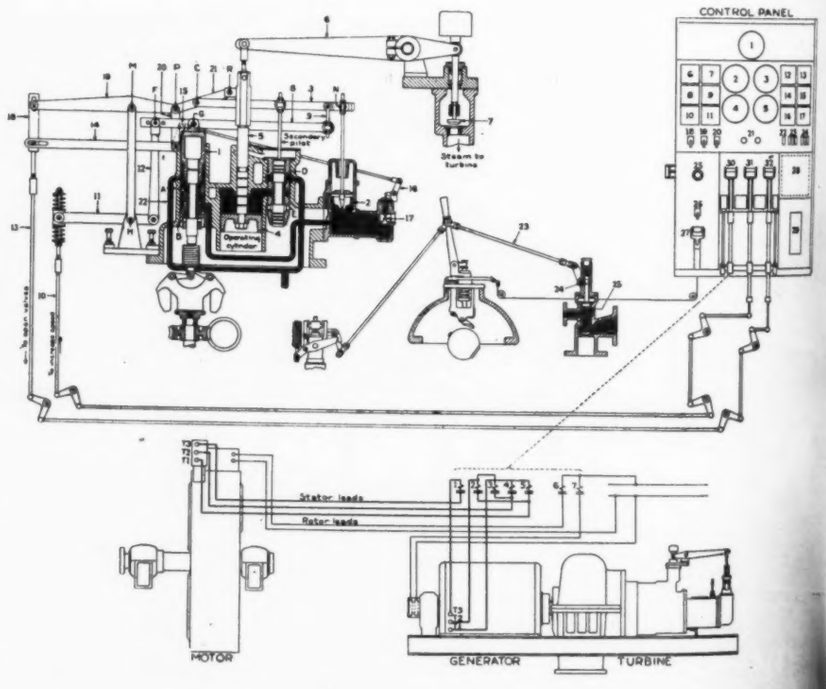


Fig. 9. Schematic diagram of propulsion equipment

UNDER CONTROL"

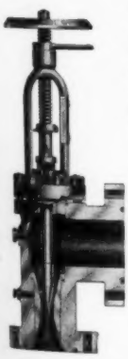
Cellar Control Gate (Illustrations Nos. 7 and 10) where a positive seal is effected against both the top and bottom inside faces of the gate body, as well as around the pipe, or indefinitely when all tools are out of the hole. The improved Shaffer Combination Rotating Blow-Out Preventer and Stripper permits adding doubles or stripping drill pipe merely by raising or lowering the drill pipe. The Stripper rubbbers are moulded for packing-off around square, hexagonal or octagonal Kellys, at the same time acting as a Stripper for standard joint, upset or flush joint drill pipe.

The increasing use of small size drill pipe in large casing (with Shaffer Cellar Control Gates having a correspondingly large bore) is responsible for Shaffer Self-Centering Rams (illustration 8) which centers such small diameter drill pipe in the bore of the gate in proper alignment with the rubber faced bore of the rams.

Many other efficient Shaffer Products, for handling high pressures and for all manner of "fishing" service, are completely described and illustrated in the Composite Catalog, or in the Shaffer Catalog which is gladly sent to any oil man upon request.

6 Shaffer Adjustable Flow Beans control the flow and regulate both pressure and rate of flow with great accuracy. They operate in any position and are extremely simple and easy to adjust for changing conditions.

7 Simplicity and strength are instantly apparent in Shaffer Type 38 Cellar Control Gates. Ram rubbers that seal top, bottom and around the pipe—stainless steel operating screws with ball races to take the end thrust and facilitate operation under excessive pressure—nothing has been overlooked to provide protection and safety.



8 Self Centering Rams (described above) can be furnished for both Type 34 and Type 38 Gates.

9 The surface string is welded to the Flangeless Base Plate of this Shaffer Full Opening Spool Type Landing Head which has a Tubing Head flanged to the upper head.

10 In addition to increased safety and operating convenience, the new Shaffer Type 38 Cellar Control Gates require a minimum of vertical cellar space and are "streamlined."

11 Shaffer Production Hook-Ups and Christmas Trees are made to meet any specifications as to pressure and operating conditions. They are assembled and tested at the plant and shipped in units for easy installation.

12 The Shaffer Universal Tubing Control Head serves as a blow-out preventer while drilling in and tubing the well. May be equipped with Stripper for safety while raising or lowering tubing in the well.

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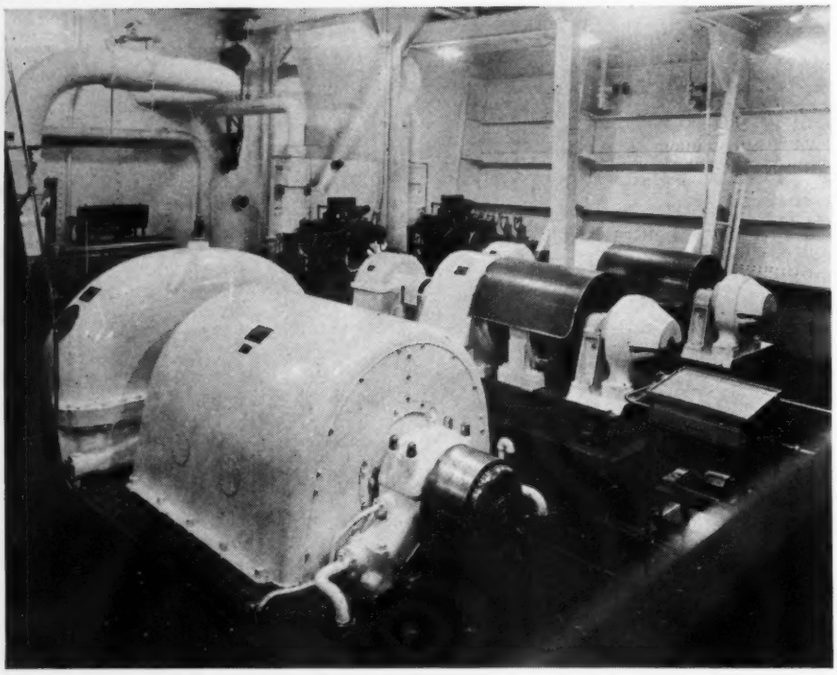


Fig. 10. Turbine flat from switchboard

for any length of time, it is then brought up by hand to 60-cycle speed. When the main unit is again above 52 cycles, the auxiliary generator can be returned to motor operation as follows: The main and auxiliary generators are synchronized by means of a synchronizing device on the auxiliary turbine governor. The circuit breaker is then closed and the speed governor reset at its lower limit (52 cycles), which cuts off the steam but leaves it ready to open and cause the turbine to reassume the load automatically if the main generator speed again drops below 52 cycles.

The compactness of both the main and auxiliary units and the convenience and "shipshape" arrangement of machinery made possible by electrification are clearly shown in Figs. 10 and 11.

Fig. 10 is taken from above the switchboard looking forward and to starboard across the main generator and the two auxiliary sets.

Fig. 11 is taken from the bridge across the forward end of the engine room and looks down and aft. In this photograph the main generator is in the center foreground with one of the auxiliaries to the left and the steam gauge panel board to the right. Across the center is the switchboard with the main control panel in the center, the three cargo pump panels at the right, and the auxiliary panels at the left. At the extreme left beyond the auxiliary panels may be seen the control panel for all the various motors throughout the ship. In this connection, note that equipment cannot be started from this panel, but only by means of push button stations located at the equipment. Behind the switchboard on the left may be seen the relays and on the right the 2300-volt-440-volt oil-filled transformers. The table full of instruments in front of the switchboard is a temporary installation of test instruments.

It is interesting to note that the main motor is almost directly under the panel board so that the main power leads are only about 15 ft. long from generator to switch panel and down to the motor.

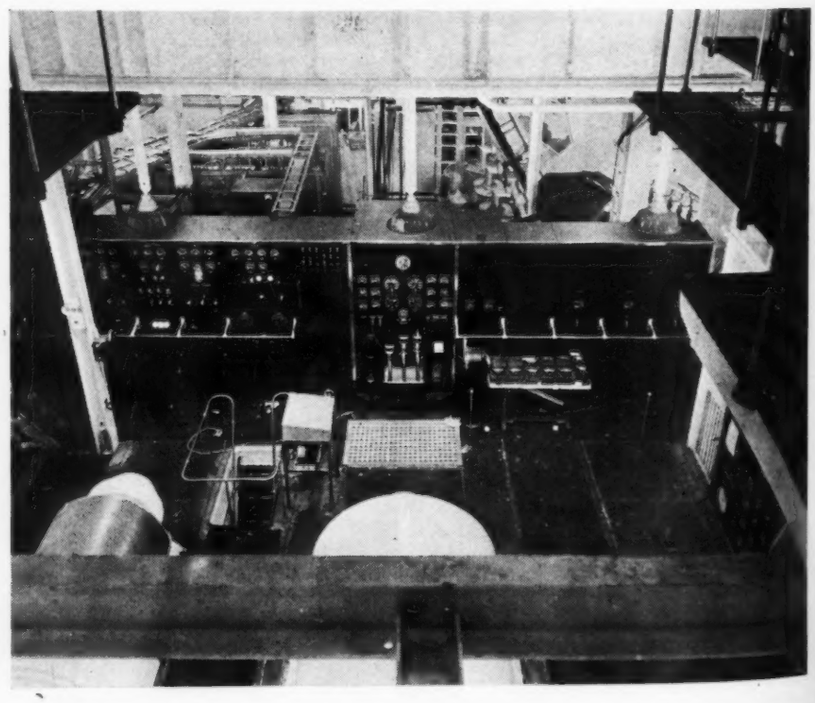


Fig. 11. Main switchboard looking from above

Condensers

The main condenser is of the divided type with a divided hot well so that in case of leakage being indicated in either side, that side can be shut down and the leaking tube plugged while operation continues with only a slight reduction of vacuum. This condenser is bolted directly to the main turbine, most of its weight being taken by spring supports.

It has 4775 sq. ft. of ¾-in. 70-30 Cu-Ni tubes, 14 ft. long between tube sheets, solidly rolled at both ends. Expansion is provided for by bellows joints in each side of the shell. It is rated at 35,300 lb. per hr. at 27.44 in. vac. with sea water at 76.8 deg. fahr., which is the average for the conditions under which this ship is to operate.

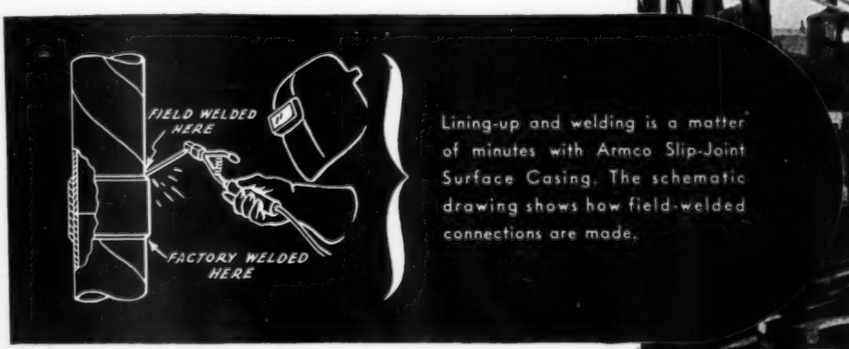
The auxiliary condenser has only a single bundle of 800 sq. ft. effective surface. The tubes are of the same material, size, and length as the main unit so that only one set of spares is required. As in the main unit, the tubes are rolled in at both ends and expansion is provided for by a bellows in the shell.

This unit has a capacity of 6000 lb. at 28.44-in. vac. with 76.8 deg. sea temperature. This corresponds to the

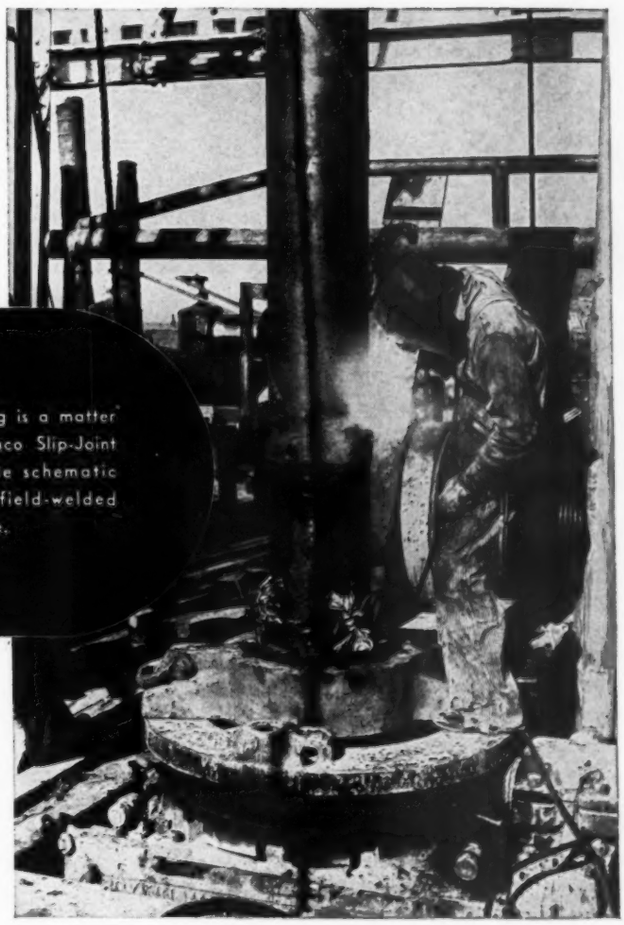
do you run Surface Casing *this fast?*

Five minutes per joint is considered exceptionally fast. Yet that was the average running time for a 900-foot string of 9⅝-inch Armco Slip-Joint Surface Casing set recently near Jal, New Mexico. Two welders—laying two beads to each weld—finished the job in 2½ hours.

In one of the Texas fields another major company set 650 feet of 13-inch Armco casing in 3 hours. Using only one welder and two beads to each weld, the average running time here was 8 minutes per welded joint.



Lining-up and welding is a matter of minutes with Armco Slip-Joint Surface Casing. The schematic drawing shows how field-welded connections are made.



• Speeds like those reported above are typical of the savings you can make with Armco Slip-Joint Surface Casing. Because it's designed to provide ample strength *without excessive weight* Armco casing is easy to handle and set. Line-ups are made quickly and accurately within the slip-joint collar because the shoulders of the pipe are cut perfectly square on a lathe-type machine. No need for line-up clamps or special ends on slips, tongs and elevators.

Total savings often run as high as 37% because Armco Casing also costs less than heavier pipe. Then too you eliminate expensive threaded ends which are of little value when casing is cemented in place. Immediate delivery of Armco Slip-Joint Surface Casing can be made throughout the Mid-Continent area and Illinois from stocks maintained by our distributor. Phone, write or wire your needs to their nearest store, or to The American Rolling Mill Company, Pipe Sales Div., Middletown, Ohio; 538 Mayo Building, Tulsa, Oklahoma; 3500 Maury Street, Houston, Texas.

ARMCO SURFACE CASING

Distributed by: NATIONAL TANK COMPANY, TULSA, OKLAHOMA AND BRANCHES

Fig. 12

output of one auxiliary unit at 105 percent load.

It can also handle the output of both units at 70 percent load (8000 lb. per hr.) at 28.1-in. vacuum.

The auxiliary condenser is connected by a header to the main condenser and the auxiliary turbines exhaust into this header. Valves are provided to shut off either auxiliary unit and to permit the operating unit to exhaust either into the auxiliary or the main condenser.

The arrangement of the circulating water system is unique and merits some explanation.

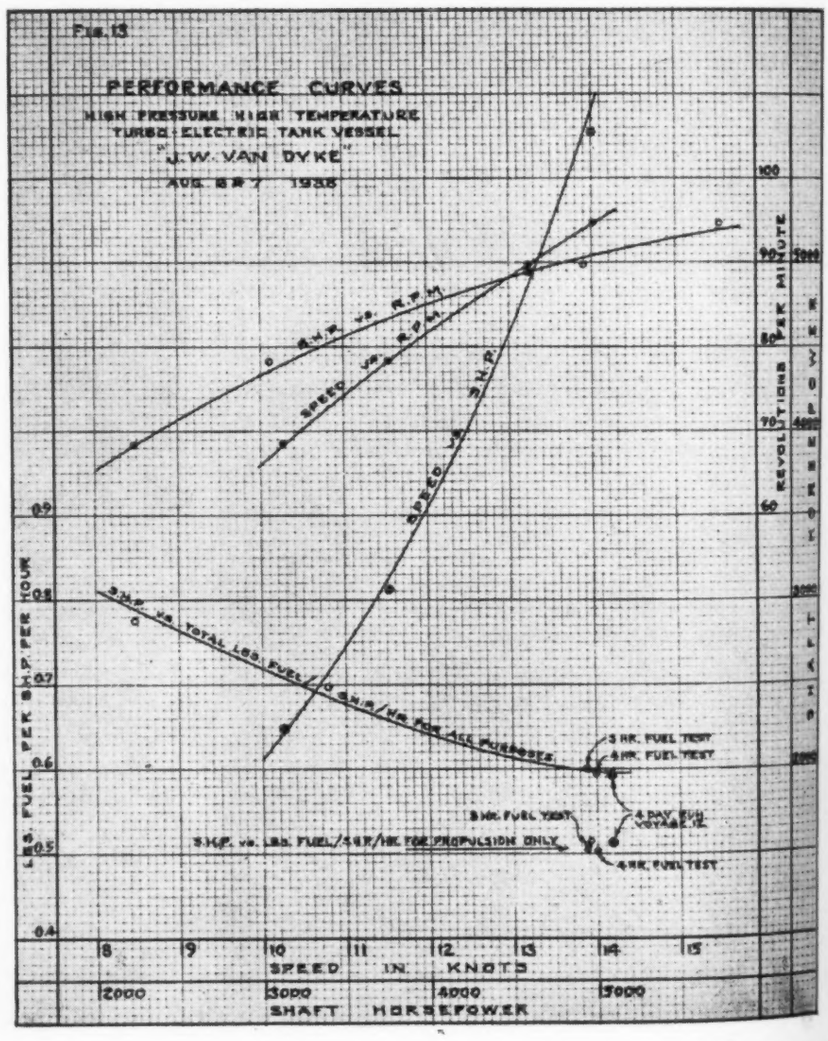
It has long been recognized that the principal cause of condenser tube corrosion is entrained air. Many attempts have been made to eliminate the trouble by such means as water box vents, "stream lining" of water passages, flaring of tube ends, etc., all of which have helped, but which seem to be "locking the stable door after the horse is stolen."

An attempt has therefore been made to arrange the sea suction so that the entrained air is removed before the circulating water even reaches the pumps. In order to accomplish this, a chamber has been provided between the tank top and the skin of the ship. The sea connections are made into this chamber. Baffles and vents are provided so that any entrained air is separated and removed before the water reaches the intakes of the circulating pumps, which are at the bottom of this chamber.

Examination of the condenser tubes in the SS "J. W. Van Dyke" after six months of operation indicates that this is proving effective as there was no sign of any pitting of the tubes. The impellers of the circulators were also examined and likewise showed no signs of corrosion or erosion.

It is believed that this arrangement will prove to be an important contribution to the protection of both condensers and circulating pumps.

The circulating pumps are of the so-called "deep well" type, having mixed-flow type impellers at the lower end of vertical shafts driven by hollow-shaft vertical motors. Each pump normally supplies one side of the condenser, but they are manifolded so that both sides of the condenser can be supplied from one pump. (When this is done, there is a loss of vacuum



of about ½ inch. These pumps also supply the generator and motor air coolers and the lubricating oil cooler.

The remaining engine room machinery is not described in detail but a summary list accompanies this installment of this article.

For those who may fear that the use of turbo-electric equipment instead of gear drive adds unduly to the machinery weight, it will be of interest to note that:

The main turbine generator weighs	91,000 lb.
The main motor weighs	107,000 lb.
The air coolers and motor cooling fan weigh	6,100 lb.
The propulsion control equipment weighs	7,600 lb.
Total	211,700 lb.

The total dry machinery weight of the entire ship is only 423 tons, including deck machinery and cargo pumps.

The total weight of power plant and auxiliaries only is 405 tons (wet). This equals .08 tons per shaft horsepower. The usual figure for a geared turbine ship of this power is 0.11 to 0.12 tons per s. hp. (550 to 600 tons); for direct Diesel, or Diesel-electric drive, it is 0.11 to 0.14 tons per s. hp. (550-700 tons).

This low machinery weight is reflected in the unusually high ratio of deadweight to displacement obtained for the ship, the figure being .758, which is considered very good, especially in view of the extra large cargo pumping equipment installed.

Expressed in another way, the lower machinery weight alone permits the carrying of 1000 to 2000 bbl. more cargo.

Cargo Pumps

As stated earlier, it was necessary to provide cargo-pumping equipment of sufficient capacity so that the ship can be unloaded between tides. This required pumps of a total capacity of 10,500 g.p.m., giving an actual pumping time of approximately 10½ hours.

In order to take advantage of the ship's generating equipment, it was decided to use "deep well" pumps, equipped with 2300-volt motors, as with this arrangement the motor room can be completely separated from the pump room except for the shafts, which pass through stuffing boxes at each end of the cover pipe with bleed-offs to the suction side between them.

The pumps are 3-stage centrifugals rated at 3500 g.p.m. at 1750 r.p.m. against 80-lb. pressure on gasoline and 90-lb. on crude oil, and requiring 220 and 245 hp. respectively. At maximum load on salt water, the power requirement is 300 horsepower. No stripping pumps are used, but instead, the cargo pumps are set in suction boxes, which in turn are connected to vacuum priming pumps through float boxes so that as long as a suction box is filled with liquid, the suction to the vacuum pump is closed by the float. If air enters, it passes into the float chamber, the valve opens and the air is drawn off through the vacuum pump, thus restoring suction to the cargo pump. The intakes of the cargo pumps being close to the bottoms of the suction boxes, the pumps continue to operate at full capacity until the tanks are practically empty as is evidenced by the fact that the Van Dyke has discharged her cargo in as short a time as 10 hours and 6 minutes, and normally discharges in less than 11 hours. Her sister ship, the SS "Robert H. Colley," established a record of 9 hours and 21 minutes to discharge her cargo of 138,069 bbl. of crude oil.

Miscellaneous Electrical Equipment

All pumps and fan motors are totally enclosed, Class 2 Marine type except the main motor, which is ventilated by a separate motor-driven fan, and motors in locations classed as hazardous, which are explosion proof, Class 1. This latter group includes the cargo pump, the cargo priming pump, and pump-room bilge-pump motors. The deck machinery motors are also of explosion-proof, Class 1 construction.

All motors except the steering gear motors are provided with overload relays.

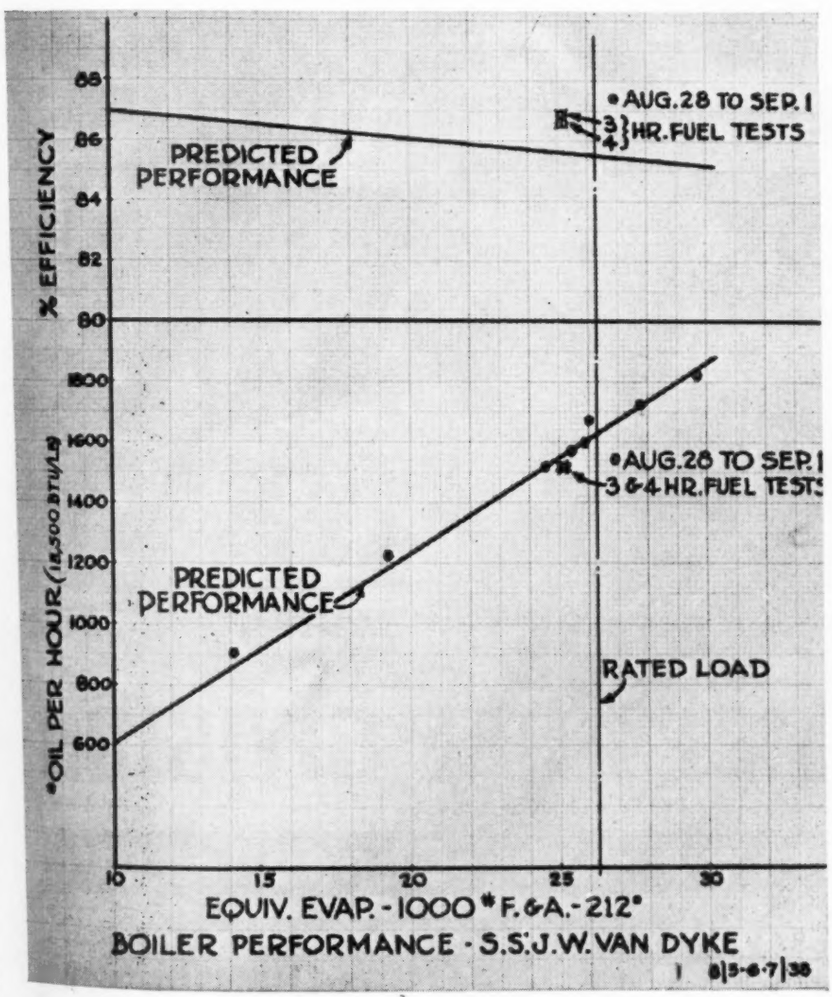


Fig. 14

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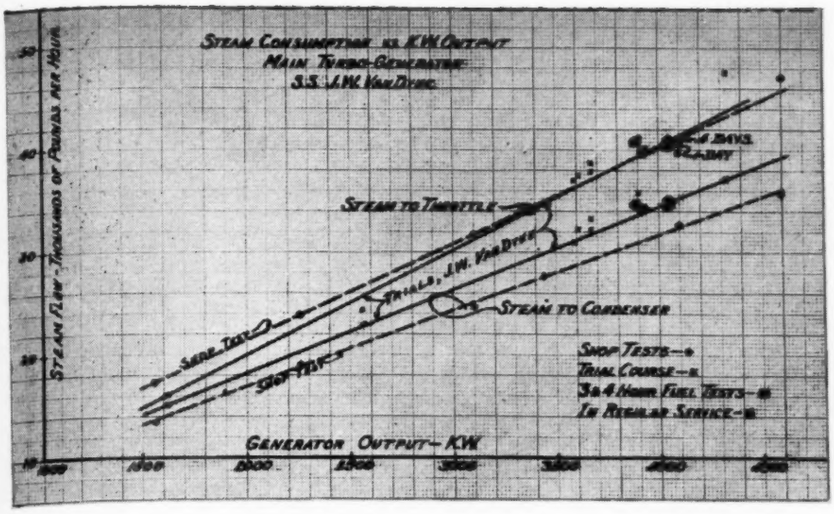

Fig. 15

The steering gear motors, and the lights and galley service are on an automatic transfer between the two auxiliary units. Certain other motors are equipped with sequential relays to restart automatically after a power failure in the following order (1) main lubrication oil pumps, (2) main circulators (3) forced draft fans, (4) main condensate, (5) fuel oil service.

In connection with the electrical equipment, the problem of carrying the cables forward to the cargo pump room and the midship house was given considerable thought and it was finally decided to provide the fore-and-aft gangway on deck with solid sides instead of open railings and to run the cables along the inside of these where they are not only amply protected but are easily accessible.

This gangway, with its cables, is illustrated. (Fig. 12.)

The 2300-volt cables are further protected by a box cover which can barely be seen where the cables turn down to enter the cargo-pump motor room in the foreground.

Steering Gear

The steering gear proper is of the conventional electric-hydraulic type with horizontal opposed rams connected to a tiller on the rudder stock and with power furnished by duplicate Hele-Shaw type oil pumps, driven by 20-hp., 875-r.p.m. induction motors. The steering control, however, is somewhat unusual in that there is no mechanical shaft or hydraulic telemotor connection between bridge and steering gear compartment, either for normal or emergency steering. The system used consists of two entirely independent electrical controls using Selsyn motors, and separate circuits from bridge to steering gear. One of these controls is arranged for either hand or automatic steering through the usual gyro-pilot and is a full follow-up, self-synchronizing system. The alternate control is a non-follow-up type operated by means of a small lever on the right hand side of the steering stand. Any one of these three steering methods, automatic, hand, or emergency non-follow-up, is instantly available to the helmsman without moving from his position by simply shifting the three-point selection lever on the left side of the steering stand. At the after end of the ship, for operating the steering gear hydraulic valve, are two Sperry power units, one connected to the automatic and normal hand steering control described above, and the other to the alternate non-follow-up control. Each of these power units is connected on its output side to the hydraulic valve mechanism through a magnetic clutch operated by the selector lever on the bridge steering stand so that the unit not in use is disconnected.

In addition to the above described steering controls from the bridge, the ship also has two emergency steering stations aft, one on the aft end of poop deck house and the other on the poop deck close to the stern. The former is a mechanical rotating shaft control directly to the hydraulic valve on the steering gear and the latter is the usual hand gear operating directly on the rudder stock through spur and worm gearing and a quadrant.

Trial Results

General. On August 6th and 7th, 1938, after having been in service about 5 months, the ship was put through a series of speed, horsepower, and fuel consumption tests over a measured mile at the Delaware Breakwater and off the Delaware Capes. The results of the horsepower and speed tests are shown by the heavy curve on Fig. 1 and the performance curves on Fig. 13. Fig. 1 also shows the model basin results. It can be seen that the

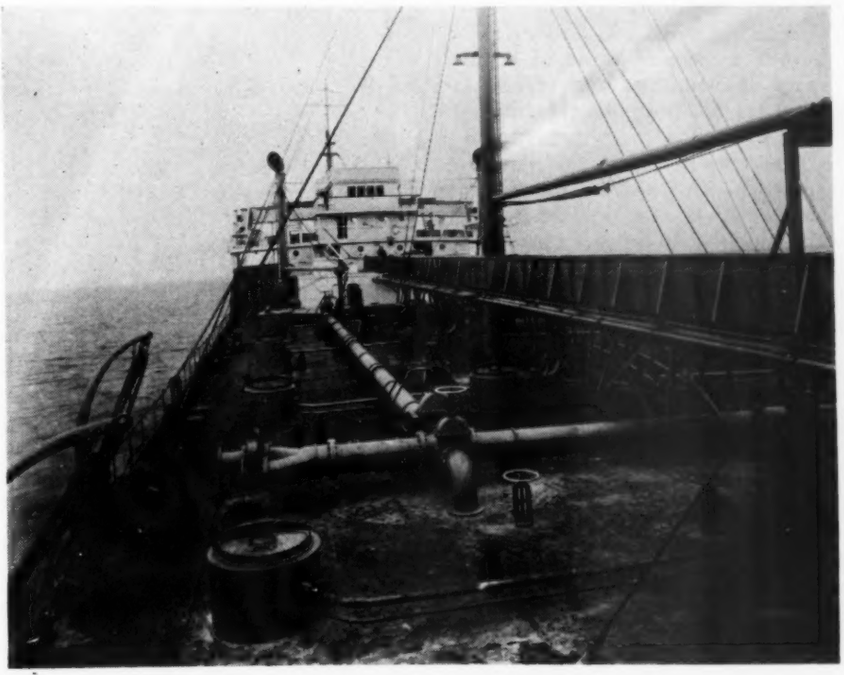

Fig. 16. View of bridge looking forward from poop deck

ship performance curve comes within the usual allowance of 12 percent to 15 percent added to E.hp. as obtained on the model, to allow for sea conditions, etc. It should also be noted in this connection that the ship was fitted with bilge keels while the model was tested without them and the depth of water over the trial course was not as great as is generally considered desirable if speed is not to be affected. The empirical formula (10 × draft in ft. × speed in knots, divided by the square root of the ship's length in ft.) gives a close approximation to the minimum desirable depth and in the present case, the actual depth was about 60 percent to 70 percent of the 180 ft. given by this formula.

Minimum turning radius tests were made both to port and to starboard at full speed and showed a diameter of turning circle of 0.47 nautical mile to port and 0.45 mile to starboard, the time to turn through 180 deg. being 3.6 minutes in each case.

A test of the steering gear showed that, with the ship at full speed, in full loaded condition, the helm could be put from hard-over to hard-over in 17.8 seconds with a maximum load on one of the two 20-hp. steering gear motors of not much more than half its rated capacity.

With the ship in full loaded condition and going full speed ahead a full speed astern bell stopped her headway in 5.08 minutes in a distance of 0.40 nautical mile.

A similar test, in which the propulsion motor was stopped instead of being reversed, gave results in which the ship drifted for approximately 1 mile in 14.05 minutes before stopping.

Both of the last two tests were made against a moderate wind of approximately 13 knots per hour velocity and against a tidal current of possibility 1 knot per hour.

Power Plant. It was of course impractical to arrange for the measurement of every quantity and temperature throughout the entire steam and water cycles as indicated on the heat balance diagram (Fig. 4), but boiler meters were provided, and a recording and integrating flow meter for the steam to the main turbine. Thermometers and pressure gauges were installed at all important points so that it has been possible to determine fairly closely and without any unwarranted assumptions how close the actual results came to our theoretical expectations.

Boilers. Here it was possible to determine the output and efficiency quite closely. Curve (Fig. 14) shows the expected performance from which it will be noted that the boilers were designed

MACHINERY SUMMARY — SS "J. W. VAN DYKE"

No.	*Unit*	*Capacity or Size*	*Power*
2	Boilers	22,500 lb. at 625 lb. and 835 deg.	
	Boiler controls		Air-operated
	Soot blowers		Air-operated
1	Main generator	4530-kva., 2300-volt, 0.994 P.F., 60-cycle, 3-phase	
1	Propulsion motor	5000 s.hp. at 90 r.p.m., 2300-volt, 60-cycle, 3-phase	
2	Generator and motor air coolers	2300 sq. ft. (each)	
1	Ventilating fan for main motor electric controls		15 hp.
1	Main condenser	35,300 lb. at 28.44 in. (4775 sq. ft.)	
2	Auxiliary generator sets	430-kw., 450-volt, 3-phase, 60-cycle, 0.8 P.F.	
1	Auxiliary condenser	6000 lb. at 28.44 in. (800 sq. ft.)	
4	Low-pressure heaters and drain coolers	40,000 lb. feed to 167 deg. fahr.	
1	Deaerator	43,500 lb. feed to 267 deg. fahr.	
1	High-pressure heater	50,000 lb. feed to 350 deg. fahr.	
2	Evaporators	1400 lb. per hr. each	
2	Fuel oil heaters	3000 lb. per hr. each to 235 deg. fahr.	
1	Butterworth heater and drain cooler	40 gal. per min., 160 deg.-130 deg.	
1	Centrifuge oil heater	75 gal. per hr., 60 deg.-140 deg.	
1	Evap. feed grease extractor	3000 lb. per hr. fresh water	
2	Main circulating pumps	3750 gal. per min. each	30 hp., 1150 r.p.m.
1	Auxiliary circulating pump	1200 gal. per min.	10 hp., 1150 r.p.m.
2	Main condensate pumps	90 gal. per min.	15 hp., 3500 r.p.m.
1	Auxiliary condensate pump	20 gal. per min.	5 hp., 3500 r.p.m.
3	Main feed pumps	125 gal. per min. at 755 lb.	125 hp., 3600 r.p.m.
3	Main feed pump turbines	125 hp., 3600 r.p.m.	
2	Evaporator feed pumps	1500 lb. per hr. each	1 hp., 1750 r.p.m.
2	Fresh water pumps	1000 gal. per hr.	1½ hp., 1750 r.p.m.
2	Fire and butterworth pumps	425 gal. per min. against 100 lb. (each)	
2	Engine room and forward bilge pumps	325 gal. per min.	7½ hp., 3500 r.p.m.
1	Sanitary pump	90 gal. per min.	5 hp., 3500 r.p.m.
2	Fuel oil service pumps	8 gal. per min. against 300 lb. (each)	7½ hp., 1150 r.p.m.
2	Fuel oil transfer pumps	150 gal. per min. against 100 lb. (each)	15 hp., 1750 r.p.m.
1	Lubricating oil pump	59 gal. per min. against 50 lb.	3 hp., 1160 r.p.m.
1	Heating system vac. pump	4 gal. per min. and 3 cu. ft. per min. of air	1 hp., 1750 r.p.m.
3	Main cargo pumps	3500 gal. per min. gasoline against 80 lb.	300 hp. at 2300 volts 1750 r.p.m.
1	Pump room bilge pump	160 gal. per min. against 50 ft. head	3 hp., 1750 r.p.m.
3	Cargo priming pumps	90 cu. ft. per min. each at 18-in. vac.	7½ hp., 1150 r.p.m.
2	Air compressors	60 cu. ft. per min. (each) against 120 lb.	15 hp., 870 r.p.m.
3	Forced draft fans	8500 cu. ft. per min. (each) against 4.5 in.	10 hp., 1750 r.p.m.
2	Boiler room vent. fans	11,500 cu. ft. per min. (each) against 0.1 in.	1½ hp., 1750 r.p.m.
4	Engine room vent. fans	14,650 cu. ft. per min. (each) against 0.15 in.	2 hp., 1750 r.p.m.
1	Thrust bearing (roller type)	116,000 lb. thrust (16⅛ in.)	
1	Lub. oil centrifuge	75 gal. per hr.	½ hp., 1750 r.p.m.
1	Desuperheater (for butterworth)	22,000 lb. steam per hr.	
1	Meter for steam to turbine	50,000 lb. per hr. max.	
1	Gland steam condenser	725 lb. steam + 210 lb. air per hr.	
1	Refrigerating machine	2½ ton	7½ hp., 1750 r.p.m.
3	Capstans		25 hp., 865 r.p.m.
2	Deck winches		30 hp., 200 r.p.m.
1	Electro-hydraulic windlass		75 hp., 1775 r.p.m.
1	Electro-hydraulic steering gear		Two 20 hp., 875 r.p.m.
1	Two-unit gyro pilot system		
1	Gyro compass		
1	Salinity recorder	4 point 0-10 grains	
2	Butterworth sets		
All auxiliary motors			440-volt, 3-phase, 60-cycle

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The next time you need Rotary Drilling lines, Sucker Rod or Tubing lines — you can assure a saving by specifying pre-formed rope instead of ordinary fabrication. For although pre-formed has a higher initial cost, — in these services it stands up much longer, thus costs substantially less, in the end.

There is, of course, a reason why UNION-formed (our superior pre-formed line) stands up longer in the services mentioned. Lines in these services are subjected to extra-severe bending stresses, drum crushing, and tensile stresses. This is in large measure offset by the fact that UNION-formed Rope is of pre-formed, stress-free construction. Containing no in-built, constant stresses, it is far better prepared to withstand severe stresses encountered in service.

UNION-formed offers many additional advantages. A few are that (1) its firmer body better resists drum-crushing and kinking; (2) it is not cranky, and reels evenly; (3) when cut, it holds its form and does not unravel.

Photograph below was taken at a well south of St. Louis, Okla., drilled by Hissom Drilling Co., of Tulsa. Left to right, the men are: W. B. Hissom, contractor; L. P. Nixon, Union Wire Rope Corp.; A. M. Ballard and Dan Wallace, lease owners; A. W. Tillotson, geologist; W. H. Pratt, floor man; Buddy Sexton, derrick man; George Larkin, engine man; H. L. Eley, driller; Dave Evans, tool pusher; Charles Johnson and J. B. Blankenship, Jarecki Mfg. Co.

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Improper handling will greatly shorten a rope's life. Never pull rope over the side of a stationary reel, as every loop pulled from the reel will either put in a twist or take out a twist in the rope. This produces a kinky, curly rope and frequently results in "dog legs." Reel should be mounted on a horizontal bar or turntable, and rotated to pay off rope.

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UNION WIRE LINES

The "ULTIMATE LOW COST WIRE ROPE"

to give an efficiency of 85.5 percent at the rated load of 22,500 lb. actual output at 625 lb. 835 deg. fahr. T.T. (equiv. evap. 26,260). During the trials, two fuel test runs were made; one of 4-hr. and one of 3-hr. duration. During the first of these runs, the boilers were operated at 620 lb. and 855 deg. producing 21,810 lb. per hr. each or an equivalent evaporation of 25,100. The feed temperature was 351 degrees. The stack temperature was 324 deg.; CO_2 was 14.7 percent; CO was 0.0 percent; O was 1.8 percent, showing an efficiency of 86.6 percent, stack loss 11.3 percent, and unaccounted for, 2.1 percent.

The second run was at almost exactly the same rate and conditions and showed an efficiency of 86.9 percent with stack loss of 11.3 percent and unaccounted losses 1.8 percent.

Since these tests were made, the results under normal operating conditions have shown that these efficiencies are easily maintainable. Data taken from the log of the homeward (loaded) leg of Voyage No. 12 show that an efficiency of 87.3 percent was maintained for the four consecutive full days of this run. We believe that such efficiencies can only be obtained and maintained by the almost perfect combustion conditions made possible by automatic combustion control.

Turbo-Generator. The performance characteristics of the main generator are shown by the curves (Fig. 15). The two pairs of curves show a comparison between the shop tests of the turbine and the trial results on the SS "J. W. Van Dyke." In studying these curves it should be borne in mind that the figures for the trial runs were taken over periods varying from 4 to 10 minutes and that the amount to the condenser was calculated from the amounts of stage bleed, which in turn were calculated from the rise in feedwater temperature. However, there were sufficient data taken during the 3- and 4-hr. fuel tests to permit determination of the generator performance during these runs and, in addition, points obtained by averaging the four full days of Voyage No. 12 of the "Van Dyke," as mentioned above, are also shown. In view of the close agreement of all these points, it is believed that the curves, as shown, are a fair representation of the turbine performance.

Fig. 5 shows a summary of expected results compared to those actually obtained. There are two columns under each heading, the first giving the pounds per hour, the second the amount of heat added or removed at each point in thousands of B.t.u. per hour. Below these columns is also shown the shaft horsepower (by torsionmeter), the pounds of total steam generated for all purposes per hour per s.hp., and the lb. of 19,000 B.t.u. fuel oil used per s. horsepower.

Conclusions

For the purpose of our conclusions, we are selecting from Fig. 5 the figures for 4 days of Voyage No. 12, as we believe these to be the most accurate data. From these it will be noted that the pounds of fuel per shaft horsepower for propulsion is 0.511 lb. and this figure is to be compared to 0.510 lb. predicted; however, it can be seen on this summary sheet, Fig. 5, that consumptions as low as 0.502 lb. have been obtained. We, therefore, think it fair to say, in consideration of all the data, that the power plant in its entirety has met the economy of the design.

It will be particularly noted that in arriving at the above figures, the portion of the fuel required for auxiliaries has not been included. The reason for this is that, generally speaking, all quoted figures for engines and other types of prime movers are on a shaft horsepower basis, owing to the fact that no two owners have the same requirements for auxiliaries for a given type of vessel. Therefore, it would be misleading to compare unless we can compare like things, and so the fuel figures are based on the propulsion requirement only.

It is believed that the foregoing will reveal power plant efficiencies not previously approached in this country in marine installations, and that when one considers the price differential between the fuel burned in these vessels and the fuel required by Diesel engines, that there should no longer be controversy relative to the most efficient type of power for this size power plant. It is altogether fitting that the results of the engineering disclosed in this paper be presented before this Society, for it is only an adaptation of those well-known principles, designs, and developments that have all been previously published through the A.S.M.E., that have been applied here. It is the earnest wish of the writer that more study be given and more interest shown in Ship Propulsion by the members of this Society, in the future, so that the latest developments in power plant equipment may be made available to the marine field.

Acknowledgment

It is only fitting at this time that the writer express his deep appreciation and admiration for Mr. J. W. Van Dyke, chairman of the board of The Atlantic Refining Company, for his extreme foresight in fathering this forward development, for his countless contributions to the engineering of these vessels, and for his continued patience and encouragement given the writer; to Mr. R. C. Tuttle, manager of transportation of The Atlantic Refining Company, for his extreme tolerance and wonderful coöperation; to the members of the Engineering and Construction Department of The Atlantic Refining Company for their unfailing coöperation, loyalty, and devotion for the success of these ships; and to the suppliers of equipment, as a group, who never tired of trying to make their equipment the best possible.

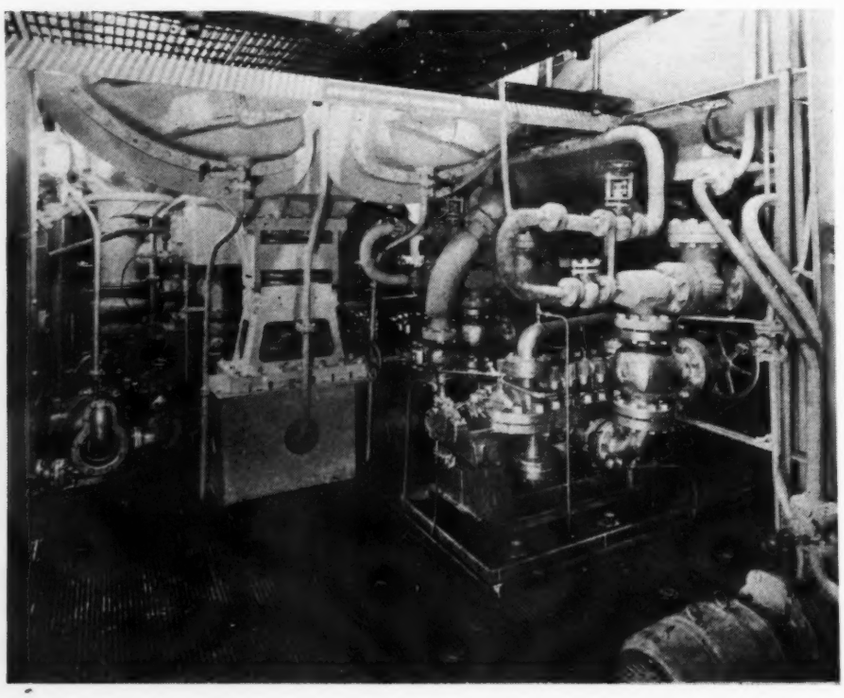


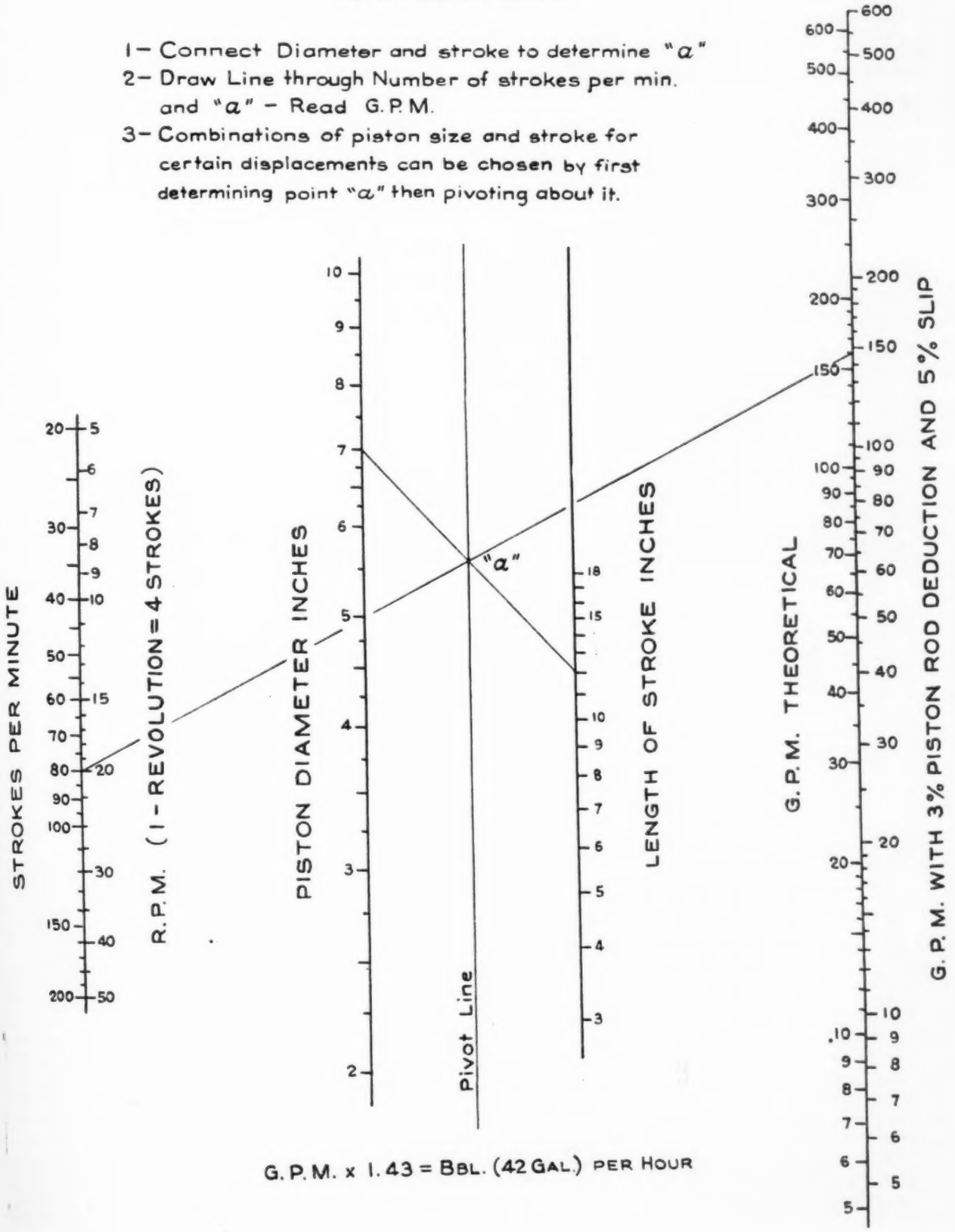
Fig. 17. Engine room showing boiler-feed pumps and spring supports for main condenser

STROKES PER MINUTE

Chart for Computing Displacement of Duplex Steam Pumps of Piston Type

By FRANK E. HANGS

1– Connect Diameter and stroke to determine "a"
2– Draw Line through Number of strokes per min. and "a" – Read G.P.M.
3– Combinations of piston size and stroke for certain displacements can be chosen by first determining point "a" then pivoting about it.



G.P.M. x 1.43 = BBL. (42 GAL.) PER HOUR

Running Tour
WITH MEN IN THE INDUSTRY

F. L. MELVILL, assistant manager of Trinidad Leaseholds, Ltd., has been appointed general manager to succeed **H. C. W. JOHNSTON,** who recently was elected to the board of directors of the company and made assistant managing director.

LAWRENCE E. SMITH

LAWRENCE E. SMITH has joined the staff of the Independent Petroleum Association of America to assist in the Petroleum Research Bureau program. He formerly was with the *National Petroleum News.*

E. P. HAYES, of The Texas Company, has been elected chairman of the Houston Chapter of the American Petroleum Institute's Division of Production to succeed **DONALD B. COLLINS,** of the Shell Petroleum Corporation. **PAUL HUBBARD,** Gulf Oil Corporation, has been chosen first vice chairman, **J. U. TEAGUE,** Humble Oil and Refining Company, second vice chairman, and **WARREN L. BAKER,** *The Oil Weekly,* secretary-treasurer.

J. W. HORNBROOK, superintendent of core drilling in Oklahoma for the Cities Service Oil Company, has departed for Peru with his family, having accepted a position with the Peruvian government to instruct and supervise geophysical and exploratory drilling with the Franks Manufacturing Corporation "Slim Hole" portable rotary and deep core-drilling units.

E. L. DECKER, of Martin-Decker Corporation, Long Beach, California, is now on an extended trip to Illinois, Kansas, Oklahoma, and Texas in the interests of his company. "Deck" attended the A.P.I. meeting in Chicago and delivered a talk before that group on the care and maintenance of drilling instruments.

On his trip he is introducing the Martin-Decker Special Weight Indicator to operators throughout the Mid-Continent and Gulf Coast and will visit the Reed Roller Bit Company, Houston, Texas, Martin-Decker distributors.

WALTER JEHU has been appointed district manager of The Timken Roller Bearing Company office, 1107 Commonwealth Avenue, Boston, Massachusetts. Jehu was formerly general manager of The Timken Roller Bearing Company, Ltd., Toronto, Ontario, Canada.

R. E. BEARD, manager of refineries in the Rocky Mountain Division for the Standard Oil Company of Indiana, has been promoted to manager of the company's Sugar Creek, Missouri, refinery. The appointment becomes effective January 1, 1939, with the retirement of **G. H. MOFFETT,** present manager of the Sugar Creek refinery.

CHARLES C. REED has been appointed general superintendent of the Hope Natural Gas Company, succeeding **WALLACE B. GRIBBLE** who retired after 32 years of service. Reed has been assistant superintendent for 11 years and has been employed by the company in West Virginia for 28 years.

CAMPBELL M. HUNTER, consulting engineer and oil-mining expert, has returned to London, England, after visiting several properties in Canada and the United States in which he is interested.

R. M. GIBBS, advertising manager of the Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania, has returned to his duties after a three weeks' illness.

JOSEPH Z. HERTZLER has returned to his former position with the Cyclops Iron Works in San Francisco, California, after a period of employment by Shand and Jurs Company.

R. E. WALKER, Tulsa, Oklahoma, district sales representative of The American Rolling Mill Company, and **L. S. "SPIDER" ALLEN,** Pipe and Coupling Department, National Tank Company, distributors, recently made a trip to the company's mill at Middleton, Ohio, for the combined purpose of studying new processes and attending business conferences.

W. A. TIPTON, manager of packing sales of the Mechanical Goods Division, United States Rubber Products, Inc., New York City, was appointed a director of the Rubber Division of the Mechanical Packing Association at a meeting of the board of directors of the association.

J. H. DUNN

J. H. DUNN, production engineer with the Lone Star Gas Company, Dallas, Texas, has resigned his position to become general manager of the Shamrock Oil and Gas Company. He now makes his headquarters at Amarillo, Texas. **LESTER POTTER,** who has been assistant production engineer, succeeds Dunn with the Lone Star.

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* Dresser Compression Coupling, Style 65, 2" I.D.

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LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

Mother: Mary—why did it take so long to say goodby to that boy last night?

Mary: But Mother, if a fellow takes you to a movie the least you can do is kiss him good night.

Mother: I thought you went to Cocoanut Grove.

Mary: Yes, Mother.

* * *

A department store ran an ad for a clerk familiar with women's underwear. There were 400 applicants—and only 15 had sales experience.

* * *

Once upon a time there was a big spinster, a middle-sized spinster, and a little bitta spinster. They came home one night and the big spinster looked in her room and said, "Somebody's been sleeping in my bed." The middle-sized spinster took a look and cried, "Somebody's been sleeping in my bed." And the little bitta spinster looked in her bed and yelled, "Whoopee!"

* * *

The waiter laughed when I spoke to him in French. No wonder—it was my old prof.

* * *

A man was boasting in the club one day that he could name any brand of spirit. Another member, taking a flask from his pocket, asked the connoisseur to taste the contents and tell him what it was. He did so, and promptly spat it out. "Hell!" he cried, "that's gasoline."

"Yes, I know," came the bland reply, "but what brand?"

—*The Core Driller.*

* * *

A fat man has one advantage over his thin brethren—he knows where his cigar ashes will fall.

* * *

Little Audrey and her boy friend had had a lot of cocktails before he took her home one night, and when she had gone to bed she looked up and saw the ceiling was going round and round, but she just laughed, because she knew that the ceiling was plastered.

* * *

The sudden entrance of a wife has caused many a stenographer to change her position.—*Bridgeport Bulletin.*

Bill calls his sweetie "Taxi" because it costs so much to get any place with her.

* * *

An Irishman in a town in the South was careless enough to let his priest catch him emerging from a saloon with a demijohn under his arm. The priest waited for him to come by and said:

"Mike, what is it you have in that demijohn?"

"Whisky, Sir."

"To whom does it belong?"

"To me and me brother Pat, Sir."

"Well, Mike, pour yours out, and be a good man."

"I can't, Father," said Mike, "mine's on the bottom."—*The Wyatt Way.*

* * *

"You should have seen the fish I caught last week. It was so big it pulled me into the river."

"Got a good wetting I suppose?"

"Oh, no; thank goodness, I landed right on top of the fish."

* * *

Gramma says that in the very near future men will eat baked beans and say: "Ah, dear, these are just like mother used to open."

* * *

Two women were discussing a mutual acquaintance.

"She has a very magnetic personality," said one woman.

"She ought to have," replied the other woman, "every stitch she has on is charged."

* * *

A brief recently filed in the Florida supreme court contained a new definition of the word "logical," given by a negro witness.

Lawyer: Did you know the defendant, Pearson?

Negro: I had a logical acquaintance.

Lawyer: What do you mean logical acquaintance?

Negro: Well we both belonged to the same lodge.

* * *

Conclusions

The young bachelor was asked which he thought were happier, people who were married or people who were not.

"Well, I don't know," he replied, "sometimes I think there is as many as is that ain't, as ain't that is."

Have ya heard about the butcher that backed into his sausage grinder?

No. What about it?

He got a little behind in his work.

* * *

New Job

"I'se got a new job, so I can't do yo' washin' no mo'."

"What is it, Mandy?"

"My new job is dat I cain't work. I'se on relief."

* * *

A doctor had an urgent phone call from a gentleman saying his small son had swallowed his fountain pen.

"All right! I'll come at once," replied the doctor, "but what are you doing in the meantime?"

Whereto came the unexpected answer, "Using a pencil."

* * *

Jones: I see the women are patronizing the barber shops as much as the men nowadays.

Green: Yes, and doesn't it serve some of these talkative barbers right?

* * *

Beware of Promises

A pretty young nurse was selling poppies. A salesman told her that he would give her a $5 bill for a poppy provided she would promise to nurse him if he ever went to her hospital. She agreed.

"By the way," the salesman asked, "where is your hospital?"

"I am at the Queen Charlotte's Maternity Hospital," meekly replied the pretty nurse, putting the five spot into the box.—*The Yellow Strand.*

* * *

Shtripped!

"What did you shay when you lost at shtrip poker?"

"I shed plenty."

* * *

Audrey Again

Little Audrey and her boy friend were sitting on a sofa when the boy friend remarked that it was so dark he couldn't see his hand before his face. And Little Audrey just laughed and laughed because she knew all the time that his hand wasn't in front of his face.

* * *

He: Why are you taking that whistle with you tonight?

She: I have a date with a football player.

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All of the above applications are illustrated and described in detail in the Baker Broadcast No. 17-A. This valuable 40-page treatise should be in your reference file... if it is not, a copy will be sent upon request.

BAKER OIL TOOLS, INC.
HUNTINGTON PARK, CALIFORNIA
HOUSTON, TEXAS

BAKER CEMENT RETAINER

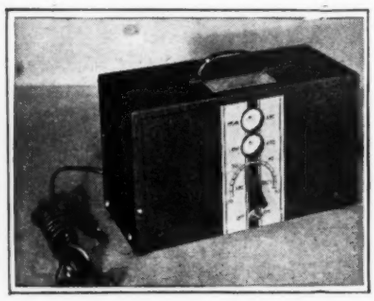
MACHINERY and EQUIPMENT

A. O. Smith Offers New Welding Control

WELDS of uniformly good quality, particularly for applications where the expense and inconvenience of X-ray do not seem to be justified, are now made possible by use of the "Arc-Length Monitor," a new product developed by the research division of the A. O. Smith Corporation, Milwaukee, Wisconsin.

In most welding applications there has been no routine method of insuring good work with this universally accepted production tool. Heretofore quality depended upon the human element, the training, experience, and attitude of the individual welder.

X-ray has proved satisfactory within limits, but is cannot be depended



upon to reveal harmful foreign inclusions in the weld metal or excessive amounts of nitrides. Various recording methods are also in use to indicate current and voltage values after completion of the weld, but these are also "after the fact" indications.

The Arc-Length Monitor is a practical development that fits into present shop practice. It helps the worker make a good weld. Smith research proved long ago that, while control over voltage of itself is no definite assurance of a good weld, in nearly every poor weld there was a relation to the voltage involved. Definite indications of voltage to the welder during the process of welding removes one of the main variables in welding technique, thus promoting higher quality welds.

The function of the device is as follows: The welder is informed of the length of his arc by means of two tiny bulbs mounted inside his welding helmet, one on each side of the window through which he observes the arc. Both bulbs are normally dark at the selected voltage. The one to the right glows with increased intensity as the voltage increases from that selected; the one to the left responds similarly as the voltage decreases from that selected. Maximum brilliance is kept well below the point of hurting the operator's eyes or interfering with his work. The instrument itself, which contains signal lights similar to those in the welder's helmet, is placed where it can be observed by the production or welding supervisor.

The Monitor will be found particularly effective where very light gauge materials are used, particularly such expensive metals as stainless steel, requiring close control of the arc. It has also proven invaluable for periodically checking the ability of experienced operators and for training new operators.

Small Twin-Crank Pumping Unit

OIL Well Supply Company, Dallas, Texas, recently added to its extensive line of pumping units the new "Oilwell" TC-8 Twin-Crank Unit of 8000-lb. polished-rod capacity. Its A.P.I. peak torque capacity at 20 s.p.m. is 38,600 inch-pounds. Stroke lengths are 20¾, 23, 26, and 30 inches. When so specified its walking beam is equipped with an attachment for second-well pumping.

The TC-8 unit was developed to meet the demand for a small twin-crank unit having many of the outstanding features of the larger "Oilwell" pumping units. An advantage that is attracting particular interest is the strong and rigid structure formed by welding a sturdy, derrick-type samson post to a widespread, structural-steel base, the makers assert. Because of this construction, the unit shows no tendency to weave under load even when installed on a derrick floor or a wooden foundation.

The speed reducer is equipped with fully heat-treated steel, single-helical, double-reduction gears. The 42.15 to 1 overall ratio facilitates the use of low-priced, high-speed prime movers. The base is extended and provided with universal slide rails for convenience in mounting the prime mover.

All speed reducer shafts rotate in tapered roller bearings; the crank pins are equipped with self-aligning spherical roller bearings, and the upper pitman and saddle bearings are bronze bushed. Oil seals retain lubricant in all bearings.

Complete specifications are contained in "Oilwell" Bulletin No. 194, obtainable at any Oil Well Supply Company store or office.

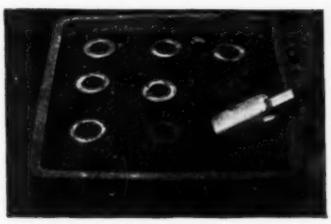
OIL IS LIFTED to a NEW LIFE ON WINGS OF AXELSON CAGES

1. Axelson Heavy Duty Cages are formed from bar stock after which milled areas between the wings are produced on duplex milling machines.

Only a part of a pump, but note the care given to it in each of the thirteen operations illustrated, out of a total of fifty required. Dozens of other parts are needed to complete the pump, and each part requires many honest and unhurried operations—hundreds in the finished unit.

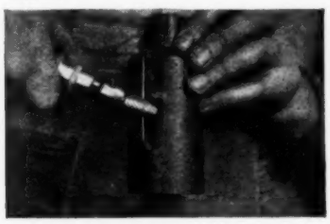
Equipped with the finest tools and machinery, Axelson factories are keyed to precision production. Here a thousandth of an inch is a big dimension. Not only are important parts checked to close tolerances, but also the tools that make them are being constantly inspected for accuracy. That's why it is safe and economical to buy Axelson products—anywhere on earth.

2. Semi-finished bore and measurements of milled areas are checked for accuracy by inspectors.

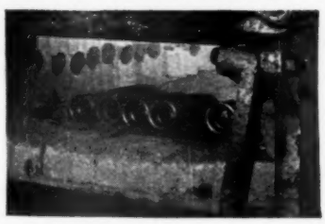


3. The semi-finished cages are carburized by pack hardening in a solid carbonaceous material.

4. After carburizing the outside surface, the main body and the pin of the cage are turned to remove the carburized surface.

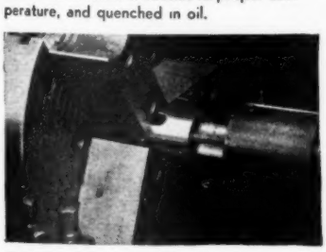


5. The carburized surface for the threaded portion on the inside is removed by boring. Burrs are removed with rotary file.

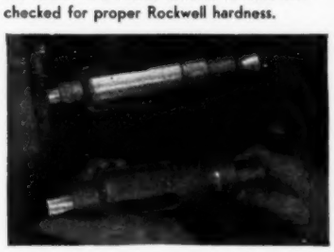


6. At this point of processing, cages are heated in an electric furnace to proper temperature, and quenched in oil.

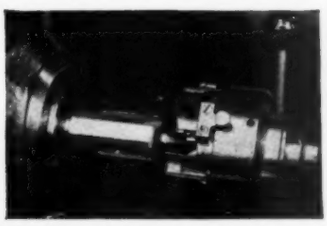
7 After hardening by quenching, the cages are drawn in a Homo electric furnace and checked for proper Rockwell hardness.



8. Cage threads to API specifications are tapped in lower end of cage after cage has been finish reamed to size.



9. The outside diameter of both body and pin of cage are finish ground to size on center and checked for proper tolerances.



10. API specification sucker rod pin threads are produced on cage pin and gaged with both "Go" and "No Go" ring gages.

11. Inside diameter of wings is ground to permit diametral clearance of .040" to .050" when using standard API ball.

12. Checking radius of pin collar with precision radius gage is included as one of the many final inspections.

13. Cages are stamped, washed, oiled and then placed on steel shelving ready for assembling in pumps or shipment as spares.

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SUCKER RODS

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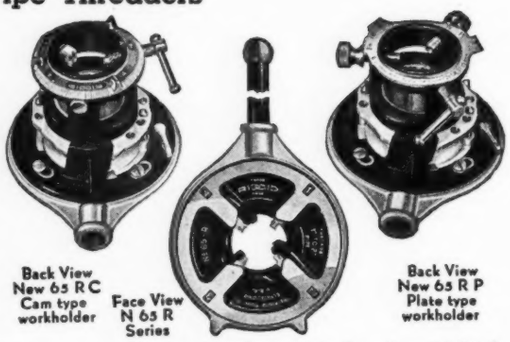
Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation • *Rocky Mountain Distributor:* Great Northern Tool & Supply Company.

Pipe Threaders

THE Ridge Tool Company, Elyria, Ohio, introduces the new Ridgid No. 65R and 85R series of pipe threaders now made of rugged all-steel and malleable-alloy construction, having drop-forged hardened tool steel cam plates, said by the manufacturer to provide quicker, easier pipe threading. The No. 65R and 85R series thread four sizes of pipe, 1 in., 1¼ in., 1½ in. and 2 in., all with one set of chaser dies. Only four dies, instead of the usual 16, made of semi-high-speed tool steel, stay in the threader.

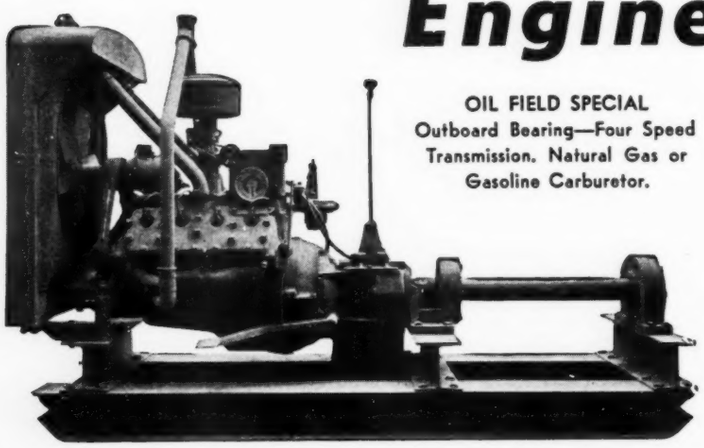


Back View New 65 R C Cam type workholder — Face View N 65 R Series — Back View New 65 R P Plate type workholder

The new No. 65R and 85R series pipe threaders offer a choice of two mistake-proof, virtually automatic workholders, a cam type and a plate type, the makers assert. There are no bushings—both types simply set to pipe size and are tightened with one screw. These workholders take 2-in. couplings for threading 2-in. close nipples. Closed chaser slots on the die face will not stretch, it is stated.

This manufacturer also has announced a new Ridgid series of poster pipe threaders of all-steel and malleable-alloy construction. Four sets of chasers thread 1-in. to 2-in. pipe. Full-floating posts are replaceable separately. These threaders also give a choice of cam or plate type workholders, both virtually automatic. Chaser dies fit any make of poster threader and all dies of the same number are identical and are interchangeable with any similar number of any other Ridgid Poster set.

New 95 H.P. Engine



OIL FIELD SPECIAL
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Six other models of General Power Ford V-8 Conversion Units are now available with three sizes of engines — Ford V-8, 60 h.p., 85 h.p., and 95 h.p.—all known for their dependability and low cost operation.

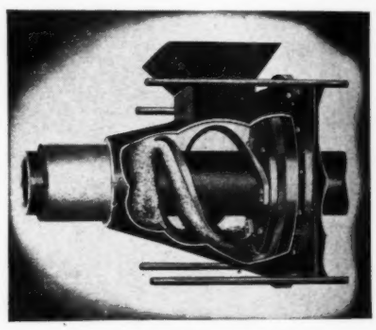
These units are available with single, dual, and multiple engines for drilling, pumping, and generating installations. When service is necessary it's as near as your local Ford dealer, where engine and engine parts exchange plan is available.

Write for complete catalog

GENERAL POWER, Inc.
Quapaw, Oklahoma — Phone 64

Armor-Clad Protection for Pipe Lines

ARMOR-CLAD, a new process of coating pipe with cement or bituminous concrete, has been introduced by the American Pipe and Steel Corporation, Alhambra, California. This method of application, by means of a specially designed, patented machine, makes it possible to obtain a



continuous, dense, uniform outer jacket that forms a perfect, seamless bond with the pipe, the manufacturers state. This type of protective covering is intended to be permanently effective.

The Armor-Clad process is based on the theory that any properly prepared material can be made to adhere tightly to pipe if it is submitted to continuous rubbing pressure; however, such plastic materials must be of the proper consistency, similar to that of bituminous and concrete Armor-Clad formulas, to respond to the spiral rubbing, troweling, and tamping action that is the secret of the success of the process, it is asserted. Coatings, after being submitted to tremendous pressure, are held firmly in position by atmospheric

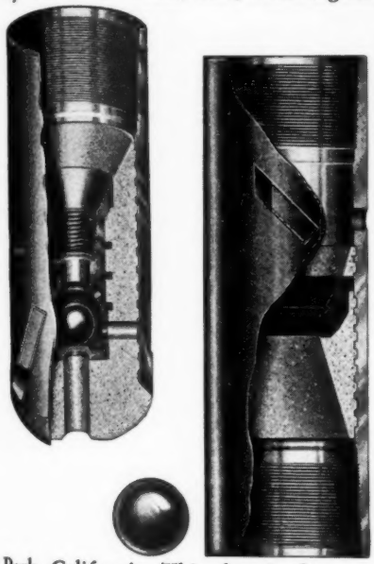
pressure because of the intimate contact of steel and plastic.

Subjected to severe tests, Armor-Clad has proven to be strong and durable, impervious to the destructive forces of corrosion, electrolysis, abrasion, and soil stresses, according to the manufacturers.

One of the most unusual, and vitally important, factors that contribute to Armor-Clad's economy of application, is that pipe lines can be coated in the trench without interruption of service in any way, it is stated. The light steel construction of the machine facilitates its being taken into any territory, no matter how difficult the terrain. It is adjustable to various sizes of pipe and can apply coatings of thicknesses ranging from ⅝ in. to 2 inches. Easy removal of parts provides for the passing of obstructions and joints.

Cementing Equipment

A FLOAT shoe of new design that is particularly adaptable for two-stage cementing and for single cement jobs that require high pressure to put-away the cement or to break circulation without putting a strain on the liner or casing has been announced by Baker Oil Tools, Inc., Huntington Park, California. This shoe is the new Baker Duplex Cement Wash-Down Whirler Float Shoe and provides for the placement of the slurry through tubing or drill pipe. When a second stage is to be cemented above the shoe, the new Baker Whirler Bridging Collar is placed in the pipe at the bottom of this upper stage.



The internal mechanism of this shoe consists of a concrete plug in which is embedded a ball-type float and back-pressure valve. Leading from the central fluid passageway through the shoe are ports, at the outer end of which are baffles. These baffles direct the flow of fluid or cement slurry in a downward whirling motion. The valve cage extends to the top of the concrete plug and at the top is equipped with left-hand square threads.

The Baker Whirler Bridging Collar used for the second stage of cementing consists of a whirler collar, below which is a seat for a bridging ball. This seat is made of Bakelite and is embedded in a concrete plug, through which is an opening large enough to pass the cementing string used to cement the lower stage. After the cementing string has been withdrawn upon completion of the first stage, a bridging ball is dropped into the liner or casing and seats in the bridging collar. This forms a bridge in the pipe and forces cement then pumped down to pass through the whirler ports in the collar. The cement can be placed by the conventional plug method or through a cement retainer set above the ports when high pressure is required to break circulation or place the cement slurry.

THREE important steps in making J-M 420 Rotary Lining are shown in the photo above.

The "cabled" asbestos yarn at the extreme right has been specially processed for extra strength. It is tightly woven into a dense, compact fabric; compressed and impregnated with a newly developed compound that has high resistance to heat. The result is a lining that is giving unusual service on rotary brakes. J-M 420 Rotary Lining has these important advantages:

UNUSUALLY EVEN FEED-OFF, giving better control of drilling . . .
HIGHER BRAKING EFFICIENCY, even at extreme temperatures caused by heavy loads . . .
LONGER LIFE under any conditions . . .
LESS SCORING OF DRUMS, giving longer drum life.

In the short time since the new J-M 420 was introduced, this rugged, lasting lining has sold both owner and driller on its superior braking performance. For full details on J-M 420 Rotary Lining and on all J-M Friction Materials, write Johns-Manville, 22 East 40th Street, New York City.

Johns-Manville 420 ROTARY LINING

Tulsa-Type Pipe Line Scraper

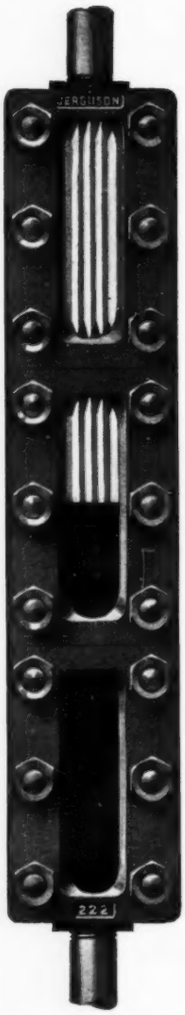
THE new Tulsa-Type pipe-line scraper manufactured by the Tulsa Boiler and Machinery Company, Tulsa, Oklahoma, supplements the other two Tulsa-Type pipe-line scrapers of the knife and brush types and has been developed to clean particularly long gasoline lines. After the knife or brush type scraper is first used to clean a line badly blocked with sediment or corrosion, this plug-type scraper will keep the line clean with minimum effort, the makers assert.

The scraper consists of a driving section using driving-discs of special composition rubber flexibly connected to a cleaning head that is interchangeable with any one of three types—plug, knife, or brush type. All parts subjected to wear are heat treated to assure maximum life and all parts are made interchangeable whenever possible. Skeleton of the scraper is the same for the 6-in. and 8-in. sizes, and is readily changed from one size to another by changing guide arms that drive discs and brushes or knives. When converting one type scraper to another type it is only necessary to remove one unit.

In addition to the interchangeable feature of the three types of scrapers, parts are also interchangeable for 6- or 8-in. lines. One skeleton and the few extra parts make available three type scrapers in two sizes. Wearing parts are made of special heat-treated steel, twin guide wheels mounted side by side now replace the former single wheel, teeth are cut much deeper, and bearing area is four times greater. Driving discs are a special composition rubber, which the action of gasoline or crude oil in the line tends to expand, forcing them closely against the inner walls of the pipe, maintaining a tight seal the full length of the line, it is stated.

JERGUSON

REFLEX GAGES



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Spang Cable-Tool Drilling Equipment

AMONG the new equipment being manufactured by Spang and Company, Butler, Pennsylvania, for

Fig. P-253

cable-tool drilling, are the three products here illustrated.

The Spang Safety Drilling-In Head and Oil Saver (Fig. P-253) is designed to divert oil and gas from the rig during the drilling-in operation. It consists of a head fitted with wiper shut-off rings, through which the cable tools or a small size bailer may be passed with but minor leakage. A quick-acting gate valve is mounted below the head, above a diversion chamber to which the lead line is attached. An automatic-opening oil saver is mounted above the head. In Fig. P-254, the head is shown with an auxiliary top, used to adapt the equipment to the use of the various types of automatic tubing spiders, for run-

Fig. P-254

ning tubing after the well has been drilled-in.

The Spang-Ekin Drive-Pipe Head and Driver (Fig. T-260) makes the driving of drive pipe in cable-tool-drilled wells possible without the need of auxiliary drive clamps, and saves the time ordinarily required to attach them to the stem and subsequently remove them. In addition to the time saved in handling the removable clamps, the use of this equipment is said to be a safety measure for the drilling crew. Its solid construction assures a blow that strikes fairly without angular stress, it is asserted.

Fig. T-260

The Spang Cement Spray Gun is designed for use in spraying cement, or cement and Aquagel, on the wall of dry caves to hold them in place and prevent their caving, even though water later rises over them. The complete assembly consists of several joints of tubing having a loading chamber top, a bail for attaching it to the sand line, a loading door into which the mixed cement is poured, and a trip valve. The trip valve is shown in the closed position in Fig. P-246, and in the open position in Fig. P-245. This valve closes the lower end of the tubing so it will hold the load of mixed cement while it is being carried to the desired point in the well, and opens when the anchor strikes bottom. The hydrostatic pressure forces the cement outward through the small nozzles in the valve chamber.

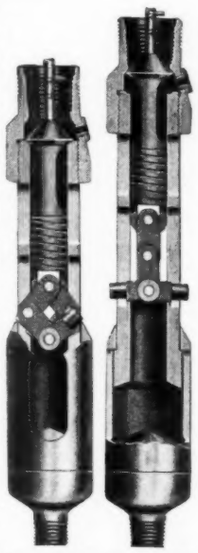

Fig. P-245 Fig. P-246

Air-Actuated Remote Recorder and Controller

AMERICAN Meter Company, Inc., Metric Metal Works, Erie, Pennsylvania, has issued a new Bulletin (E-22) completely descriptive of the Metric-American Air-Actuated Remote Recorder and Controller. This newly-developed instrument is devised for accurate recording and control of rate of flow or pressure of gas, air, steam, or other fluid, or for the recording and control of liquid level.

The sending unit, installed at point of measurement, consists essentially of a Westcott-American orifice meter differential gauge or Metric-American pressure gauge. The receiving unit, including recording chart and Metric-American controller, may be situated in the central control room or at any convenient point or distance from the sending unit.

A Metric rotary pilot in the sending unit actuates a movable bellows. This movement is transmitted by air or gas under relatively low pressure to the receiving unit, where a similar bellows, accurately calibrated with the first, motivates the recording pen arm.

The instrument is adapted to industrial processes where ordinary connecting lines are subject to freezing unless steam-traced or jacketed, or to gas formation in liquid lines or condensation of liquid in gas lines; or where it is desired to exclude main-line high pressures or such gases as propane or butane from the control room.

Protects

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A BEAR FOR WEAR

The GRIZZLY *No-Wip* LINE Saver is engineered to do a specific job—protect wire lines against excessive wear, hazardous breaks, and abuse. It takes out the whip without straightening or injuring the line which always is in direct contact with the tough rubber rollers. No metal can touch it. Simplifies spooling and prevents piling up at any area on the drum. Can be suspended at any point in the derrick; functioning perfectly at any angle. Its use will save miles of valuable wire lines every year. Detailed information in Bulletin No. 10-0F. Distributed by leading supply companies.

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GRIZZLY 'NO-WIP' LINE SAVER

Martin-Decker's "Special" Illuminated Weight Indicator

MARTIN-DECKER Corporation, Long Beach, California, has announced a new weight indicator, known as the Special. This instrument has many features not previously incorporated in a weight indicator, and is designed to measure extremely heavy loads, having 20 percent greater capacity than previous indicators, according to the manufacturer. This feature, plus a supersensitive vernier indicator having a capacity of 100 points, insures sufficient capacity to handle wells deeper than any thus far drilled, it is stated. The Special has an unusually large dial and built-in illumination that can be clearly read from any point on the rig floor day or night. Ten interchangeable dials nested within the case give direct readings in lb. for all commonly used string-ups and line sizes. The center dial is graduated in weight and vernier indicator points for the convenience of those desiring to use this system.

Two gauge hands, a regular gauge hand and a supersensitive one (six times as sensitive) enable the Special to cover all phases of drilling and production work with safety and high precision.

The entire unit is factory filled and

sealed. It cannot leak, and requires no pumping-up, no priming, and no attention of any kind, the makers assert. The use of light, tough alloys eliminates unnecessary weight, the Special weighing but 60 lb. complete. Its compact construction and light weight eliminate any tendency of the instrument to swing on the deadline in rough drilling. Another important feature is the unitized leak-proof case and shatter-proof rubber-sealed dial glass that completely seals the instrument.

Power Type Pressure Gauge

A POWER type pressure gauge suitable for measuring extremely high pressures, and said to be accurate to one-tenth of 1 percent, has been developed by Bailey Meter Company, Cleveland, Ohio.

This gauge, as shown diagrammatically in Fig. 1, provides accurate pressure readings on an indicating scale and may also transmit these readings to indicators and recorders situated at distant points, it is stated.

The pressure to be measured is applied to a small pressure piston that supports a pilot valve and a table loaded with removable weights. This portion of the pressure device, which is continuously rotated to eliminate static friction, is similar in principle to a dead-weight pressure gauge, as the applied pressure is counterbalanced by the weight of the table and removable weights less the buoyancy of the mercury on the skirt of the weight table. A small motor serves to rotate the pressure piston and pilot valve, a ball

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bearing being provided so that the removable weights and weight platform

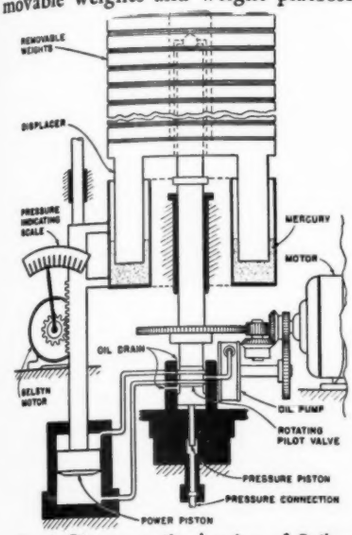


Fig. 1. Diagrammatic drawing of Bailey power type pressure gauge

need not rotate. The motor also drives a small oil pump that provides hydraulic pressure for operation of the power piston, which in turn moves the

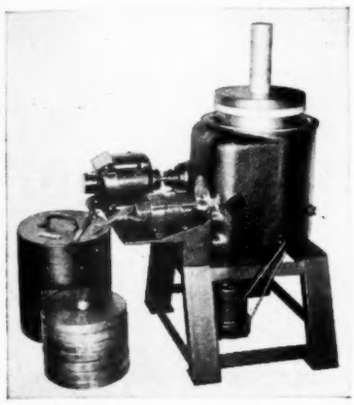


Fig. 2. Dead-weight type Bailey pressure gauge for 12,000-lb. service

mercury cup, the indicating pointer, and the Selsyn motor for electrical transmission of readings.

Fig. 3. Bailey pressure indicator having suppressed range

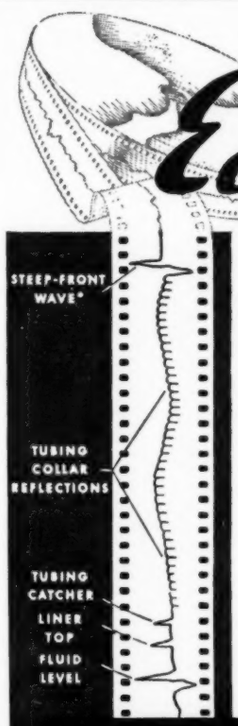
When the applied pressure increases or decreases, the pressure piston, pilot valve, and weight table rise or fall and in so doing permit oil under pressure to pass through the pilot valve to the upper or lower side of the power piston. If the pressure being measured increases, the pressure piston is forced upward and carries the oil pilot valve with it. As soon as the oil ports leading to the power piston are partly uncovered oil is supplied above the piston and is drained from the lower side. The power piston thus moves downward, lowering the mercury chamber and tending to withdraw the skirt of the weight table from the mercury bath. This action results in a loss of buoyant force that causes the pressure piston to carry additional weight so that it is forced downward and the pilot valve is returned to neutral.

In this manner, for each pressure applied to the small rotating pressure piston, a definite position of the power piston, mercury cup, and indicating pointer is obtained.

Gauges operating on this principle have been constructed for suppressed ranges and extremely high pressures.

OTIS
"Don't Kill Your Well"
Call OTIS

IGI
Echo-Meter



GIVES YOU ACCURATE FLUID LEVEL DETERMINATIONS IN A FEW MINUTES AT SMALL COST

Is your pump doing its job? This is an important question because you can't **see** your pump at work. However, ECHO-METER can give you the right answer in a few minutes without shutting down the pump, pulling rods or tubing, or otherwise interfering with production.

Our method and equipment are also designed to measure static Fluid Levels with the same speed, safety, economy and dependability.

A LOW COST SERVICE

The cost for a single ECHO-METER Fluid Level Determination is only $25.00 per well, plus 8 cents per mile for the truck; additional wells in the same day result in a materially lower unit cost per well usually averaging less than $10.00 for each additional well.

Always use ECHO-METER Service for *Accuracy, Economy, Safety* and *Speed.* Complete details on request.

INTERNATIONAL *Geophysics*, INC.

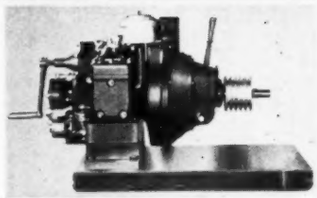
1063 GAYLEY AVENUE, LOS ANGELES, CALIFORNIA
P. O. BOX 392, GREAT BEND, KANSAS
P. O. BOX 188, LOVINGTON, NEW MEXICO
P. O. BOX 1499, KILGORE, TEXAS

NO SHUTTING DOWN THE PUMP
NO PULLING RODS OR TUBING
NO STOPPING OF PRODUCTION

Here's your
Really SMALL, LIGHT
DIESEL!
for
Well Pumping Units · Generator Sets · Compressors · Pumps · Drilling Rig Utility Outfits · Welding Outfits · All Lighter Construction Machinery
THE 12½-20 HP
COVIC DIESEL
TYPE T-2☆

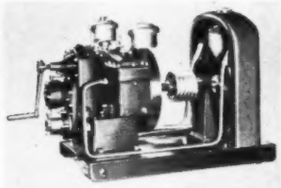
TWO MEN CAN CARRY IT...engine, ready to run weighs only 385 lbs. . . . **A YARDSTICK MORE THAN MEASURES IT** . . . only 30⅝" wide, 19½" high, 19" long . . . **FAR LESS INVESTMENT** than the far bigger, far heavier gas and Diesel engines . . . **SLASHES COSTS OF HAULING, INSTALLING, HOUSING . . . FULL DIESEL, 4-CYCLE** . . . burns same fuels as large Diesels . . . **INSTANT HAND STARTING** . . . without the aid of starting air, gasoline, spark plugs or glow plugs . . . **THOROUGHLY PROVED** —thousands in industrial use the world over.

Now available in these compact *Power Packs*

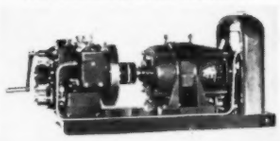


TYPE T-2-PC POWER UNIT WITH CLUTCH AND PULLEY

☆TYPE T-2 REPLACEMENT ENGINE, WITH FLYWHEEL (SHOWN ABOVE)



TYPE T-2-P POWER UNIT WITH PULLEY, FAN ASSEMBLY AND RADIATOR



TYPE T-2-G115DC GENERATOR SET (SHOWN). ALSO TYPE T-2-G32DC AND TYPE T-2-G120AC SETS

COVIC DIESEL
DIVISION OF THE NORTHILL CO., INC.
6822-26 McKINLEY AVENUE, LOS ANGELES, CALIFORNIA
Distributor-Dealer Organizations Now Established in Most Territories

SEND COUPON FOR Specifications on following Covic *Power Packs* illustrated above: ☐ Type T-2 ☐ Type T-2-PC ☐ Type T-2-P ☐ Type T-2-G115DC ☐ Type T-2-G32DC ☐ Type T-2-G120AC ☐ Covic *Power Packs* for powering requirements described in letter herewith

Firm Name _____ pe-12-38
By _____ Title _____
Address _____ City _____ State _____

Book Reviews

Minerals Yearbook, 1938, published by the U. S. Bureau of Mines. 1339 pages. 1938. Price, $2.00. Obtainable only from the Superintendent of Documents, Washington, D. C.

This annual publication is the authority on the domestic mining industry and a valuable reference for all members and students of the mineral industry. The 1938 Yearbook presents a complete economic and statistical summary of the mineral industry of the United States in 1937 and contains more data than previous editions. Final statistics on nonferrous metal mining are given for all but one state, and final figures for the year under review are presented for all the nonmetallic mineral industries and anthracite. Current trends in production, consumption, prices, technologic progress, world conditions, and foreign trade in nearly 100 metal and mineral commodities are reviewed. A comprehensive survey of the bituminous-coal industry is included, through the courtesy of the National Bituminous Coal Commission. The historical record of nonferrous metal production in the principal producing Western States is shown in graphic form. The chapter on phosphate rock has been expanded in view of the current national interest in this subject. Other important features of this year's volume are: special compilations of basic data pertinent to the lead and zinc tariffs; a complete list of sulphuric acid plants in the United States; statistics on secondary metals, and a summary of the efforts of Germany, Italy, and Japan to meet their mineral-deficiency problems.

●

Annual Reviews of Petroleum Technology, Vol. 3 (covering 1937). Published by The Institute of Petroleum, Aldine House, Bedford Street, London, W. C. 2, England. 490 pp. 1938. Price, 11 shillings ($2.75).

As in previous volumes technical advances in all branches of the petroleum industry during the preceding year are carefully reviewed, and a comprehensive bibliography accompanies each chapter.

The chapters are arranged in logical sequence and the number and variety of original sources consulted has been increased. The subject of cracking has been given special emphasis. This publication continues to improve year by year and constitutes a useful reference work at a moderate price.

New Officers of Petroleum Electric Power Club

At the closing session of the tenth annual meeting of the Petroleum Electric Power Club, held in Tulsa, Oklahoma, the following were elected officers:

O. W. Jones, Central Power and Light Company, Corpus Christi, Texas, president; H. E. Roberts, Empire District Electric Company, Joplin, Missouri, secretary-treasurer; E. A. Armstrong, Public Service Company of Northern Illinois, vice chairman.

New directors to serve two years are: K. C. Johnson, Arkansas Power and Light Company; G. A. Coleman, Public Service Company of Oklahoma; P. M. Cordell, Duane Landon, and W. G. Moore, Texas Power and Light Company, Dallas.

Directors who still have one year to serve include F. A. Graham, W. H. Stueve, G. H. Weckel, E. A. Armstrong, and J. E. Elliott.

Refiners to Hold Important Meetings at Houston Oil Show

Four full days will be devoted to papers and discussion on refinery equipment during the Oil-World Exposition in Houston, April 24 to 29, inclusive. These technical meetings will be under the direction of the refinery committee, of which W. H. Curtin is chairman.

According to Ed. G. Lenzner, general manager of Oil-World Exposition, Inc., the large conference hall on the second floor of the Coliseum, which seats 300 persons, will be assigned to the refinery meetings. This room will be equipped with loud speaker, lantern slide projector and screen, and with whatever other facilities may be necessary.

The complete program has been divided into four sections and one day will be devoted to the subjects to be treated in each section. The meetings will begin at 9 a. m. and adjourn for lunch, reconvene at 1:30 p. m. and adjourn for dinner, and will be continued in the evening from 7:30 to 9:30 p. m. Each section will be under the supervision of a sub-committee, having a sub-chairman in charge of the meetings. The personnel of the committees and the subjects to be discussed are as follows:

Chemists' Program, Tuesday, April 25th: K. H. Clough, sub-chairman, W. H. Curtin and Company, Inc.; F. W. Jessen, Humble Oil and Refining Company; A. R. Rickards, Sinclair Refining Company; E. W. Gardner, The Texas Company; W. F. Fulton, United Gas Company, and J. H. Tabony, Crown Central Petroleum Company.

Instrument Program, Wednesday, April 26th: R. L. Mallory, sub-chairman, Brown Instrument Company; Joe Peddie, Maintenance Engineering Corporation; L. G. Marsh, Taylor Instrument Companies, and G. B. Lane, Foxboro Company.

Heavy Equipment Program, Thursday, April 27th: M. N. Dannenbaum, sub-chairman, M. N. Dannenbaum Company; Joe Miller, Humble Oil and Refining Company; H. M. Stewart, Humble Oil and Refining Company, and Philip Darling, Pan American Refining Corporation.

Process Program, Friday, April 28th: George Reid, sub-chairman, editor, *The Refiner and Natural Gasoline Manufacturer*; O. E. Berg, Babcock and Wilcox Tube Company, and Karl E. Luger, Carnegie-Illinois Steel Company.

Crane Expands Research and Engineering Program

Research work that goes on behind the scenes in the plant of a large manufacturer of valves, fittings, plumbing and heating equipment, and pumps was revealed at an Open House held by Crane Co., at its Chicago Works in November. The occasion was inspired by a notable expansion in the Crane research and engineering program.

Although research work has been a part of the Crane program for half a century it has been continually enlarged in recent years until today it occupies two two-story buildings having a total floor space of 86,000 sq. ft. and a personnel of 285. The staff ranges all the way from experts in metallurgy to specialists in the field of ceramics—a body of engineers spending their entire time in the work of controlling the quality of present products and looking ahead to their improvement.

As Charles B. Nolte, president of the Crane Company, says in the foreword to a book on the Crane Research Laboratories, "Crane Company is dedicated to the philosophy that only through continuing a well-organized program of research can it best serve its employees, its stockholders, the users of its products and society in general."

This new blade-type RIDGID cutter wheel

Assures You

Quick

Clean

Low Cost

Pipe Cutting

LIKE the blade of a good knife, this RIDGID cutter wheel blade is made of fine tool steel — for more cutting power and stamina. Where ordinary wheels are cut from bar stock, RIDGIDs are coined from tool steel sheets, hammered, heat-treated and cast into a solid hub. Many more cuts per wheel, quicker cutting, practically no burr . . . And thousands of users will tell you that this steel reinforced cutter, guaranteed not to break or warp, always cuts true, twirls easily to size, stands the gaff of hard use. For a tool a good workman can take pride in, for speedier better work and less cutter wheel expense, buy the RIDGID. Ask your Supply House — today.

THE RIDGE TOOL CO., ELYRIA, OHIO

You never need repair RIDGID housings

Guaranteed against break or warp, they save you practically all pipe wrench repairs. For a safe, efficient tool and real economy, buy RIDGID.

RIDGID PIPE TOOLS

Portable Cooling Unit for Oil Field Engines

Correct Temperatures at Big Savings!

Has the Features Operators of DRILLING and TEMPORARY PUMPING ENGINES want.

Avoid Costly SHUT-DOWNS!

Guard against engine failure due to improper cooling or the use of poor water in open-type cooling systems.

Made by MARLEY—*The* name in water cooling equipment

★ SOFT jacket water in closed system externally cooled by water.

★ ONE MAN with winch truck can move it anywhere.

★ 4 STANDARD models.

★ RUGGED Strength.

Write for Full Particulars Today!

The MARLEY Co.

KANSAS CITY, KANSAS

A Long Record of Service to the Oil Industry

Look for the Arm-and-Hammer

ARMSTRONG BROS.

Vanadium Steel Dies and Chasers

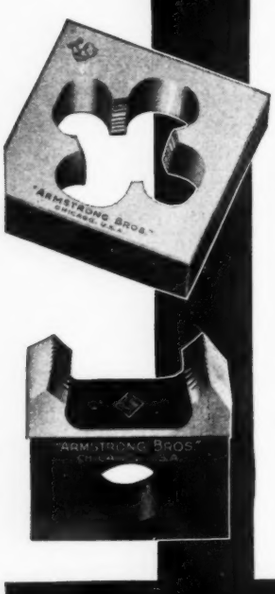
CUT SMOOTH THREADS AND HOLD THEIR EDGE

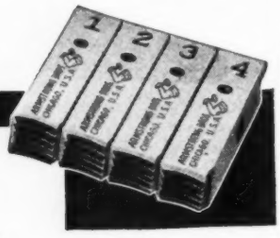
Pipe Threading is basically metal-cutting, a matter of cutting steel, cutting angles, rake and clearance. It is natural that Armstrong Bros. Tool Co., Chicago, who make the cutting tools used by over 96% of the machine shops and toolrooms, should make the best pipe dies.

ARMSTRONG BROS. Pipe Dies and Chasers are of special vanadium tool steel, heat treated and oil tempered. They have backed-off teeth, with ground points that are set at the correct cutting angle. The special design provides ample chip clearance. They cut faster, easier and hold their sharpness longer. They back-off pipe without jamming; assure tight-fitting threads of lathe-cut smoothness.

ARMSTRONG BROS. Solid and Adjustable Dies and Chasers fit all standard makes of Stocks and Threaders.

Write for Pipe Tool Catalog—the most complete line manufactured.





Armstrong Bros. Tool Co.

"The Tool Holder People"

331 N. Francisco Ave., Chicago, U.S.A.

Eastern Warehouse and Sales

199 Layfayette Sreet, New York

San Francisco London

J. E. Elliott Returns from Trip to South America

J. E. "Brick" Elliott, president of the Elliott Core Drilling Company, Los Angeles, California, has returned to the United States after an extended trip to South America on business for his company. He made the entire journey by air, flying down the west coast via Guatemala City and Panama to Maracaibo, and later continuing on through Colombia, Eastern Venezuela, and Trinidad, returning to California via New York.

During approximately a four months' tour, Elliott visited every important oil field, and many of the wildcat operations in Venezuela and Colombia. He states that present activities point to increased drilling operations in all existing fields and a considerable amount of new development work.

The Elliott company is one of the major oil-tool manufacturing organizations of this country, having pioneered the coring of oil wells on a commercial basis as far back as 1921, and its products are used extensively throughout all foreign fields.

●

Irvin Works of Carnegie-Illinois Steel Corporation Opened

The new Irvin Works of Carnegie-Illinois Steel Corporation, major project in the modernization program of United States Steel Corporation, was formally opened December 15. Dedication of the plant included an inspection trip by several hundred industrial leaders and United States Steel Corporation officials. It is named for William A. Irvin, vice-chairman of United States Steel.

The chief units of the plant are an 80-in. hot strip mill, an 84-in. tandem cold reducing sheet mill, and a 42-in. tandem cold reducing tin mill. These are supplemented by the necessary annealing furnaces and pickling and tinning departments. The mills are electrically operated and have an annual capacity of 600,000 tons.

Irvin Works is designed to meet the constantly increasing demands of customers for a wide variety of flat rolled products.

Excavation at the 653-acre site of the plant began May 22, 1937. The first rolling mill equipment was placed in operation March 2, 1938. The tin division was in operation in early spring of this year, and the entire plant is now ready for commercial production.

A.G.A. Natural Gas Section Headquarters to Be Moved to New York

The managing committee of the Natural Gas Section, American Gas Association, has announced the removal of the section's headquarters from Dallas, Texas, to New York City, effective January 1, 1939.

E. H. Poe, secretary, will remain in charge of all natural gas activities, and will continue to contact the natural gas industry throughout the United States from his new headquarters, where all other sections of the American Gas Association are now situated.

The widespread growth of the natural gas industry during the last few years, and the increase of potential markets in unsaturated territory, has prompted this move, according to members of the managing committee. Having headquarters in New York will provide contact with other organizations conducting research activities in which natural gas companies are interested, especially with respect to problems of exploration, production, and scientific developments.

Bright Outlook for Sales of Oilfield Equipment in Europe, Says Wells

"Europe is looking to America for the development of oilfield equipment and methods," reports Walter T. Wells, president of the Lane-Wells Company. Wells recently returned from a two-months' visit to England and the Continent.

During the trip Wells traveled through France, Belgium, Holland, Germany, and Sweden and met executives of the major oil producing companies in those countries. The greatest interest of European oil operators, reports Wells, is the development of modern drilling and completion methods with the view of reducing production costs. Almost every square foot of Europe is being tested for possible producing fields and, as a result, drilling operations are beginning in localities heretofore thought to be barren. The outlook for sales by American equipment manufacturers in foreign fields is particularly bright, he says.

"With overseas prospects good for 1939 and a record year for 1938 in the United States, the Lane-Wells Company plans an aggressive campaign for the coming year," according to Wells. "New field equipment is under construction, men are being trained, and we expect 1939 to be the biggest year so far in the company's operations."

Bethlehem Purchases International Supply

One of the major developments in the supply industry, and one which gives the oil industry another major service institution, was the acquisition of the International Supply Company and its manufacturing division, the Oklahoma Iron Works, by the Bethlehem Supply Corporation of Tulsa, Oklahoma. The consummation of the purchase was announced by Eugene Grace, president of the Bethlehem Steel Corporation, who, with a party of company officials, was in Tulsa to close the transaction.

The purchase was one of the most important transactions in the oil industry in recent years and enables Bethlehem to render a complete oil-well supply service to the industry. Grace expressed the wish that the personnel of the International organization should remain with the new concern, and expressed confidence in the future of the oil industry. Although no definite figure was announced, it is understood that the purchase price was more than $1,000,000 and the future program provides for a further investment of $500,000 in plant expansion and improvement of the manufacturing facilities for the manufacture of a more nearly complete line of oil-field equipment at the Tulsa plant.

The new set-up gives Bethlehem a far-flung network of approximately 40 supply stores throughout the Mid-Continent area, Bethlehem Supply Corporation having already possessed 20 stores and offices at strategic field points and now acquiring an equal number of stores operated by the International Supply organization.

Accompanying Grace to Tulsa were Paul Mackall, Quincy Bent, and F. A. Shick, vice-presidents. The Bethlehem chief announced that G. A. Tompson, executive vice-president and general manager of Bethlehem Supply Corporation, will remain in command of the Bethlehem interests in Tulsa, and expressed the hope that A. E. Ballin would remain with the company. Ballin has directed the affairs of International Supply Company since the death of its founder, James W. Sloan, and handled the negotiations for the sale to Bethlehem.

The new development was celebrated with a party at Southern Hills Country Club, and a luncheon at Tulsa Club, attended by executives and department heads of the two concerns and by oil company executives, civic leaders, and others. Leaders of the industry were impressed with the new development as an expression of confidence that better times are ahead for the oil industry and for the manufacturers and suppliers of oil-field equipment and materials.

DURING 1939
specify
B-M-W PRODUCTS

- NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.)
- ADMORE Liner Barrels
- TEX TYPE Plunger Fittings and Valves
- BALLS and SEATS (made for every pumping service) including the new B-M-W TOWER TYPE BALL AND SEAT and the new B-M-W 2-WAY NON-MAGNETIC CROWN
- ADMORE Insert Pump Anchors
- COLLINS Belt Clamps

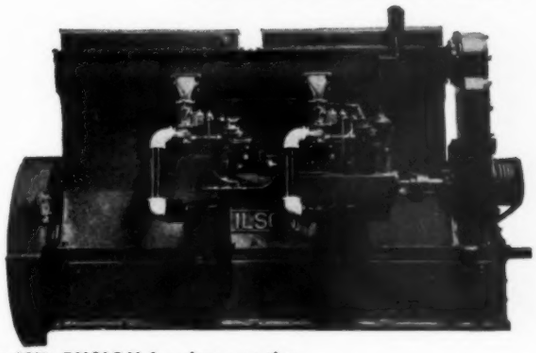
The B-M-W NEILSON
Safety Sucker Rod Hook

Here is a strong, rugged, free-swiveling, safe hook—shown at the right. Ball-bearing, enclosed in a grease-packed bail. These features, combined with a simple and dependable latch arrangement, make the hook "100% safe." Two sizes for rods—one size for tubing. Circular on request. See our advertisement in the "Composite Catalog."

Obtainable at Supply Stores

BRADFORD MOTOR WORKS INC.
OIL WELL SUPPLIES
BRADFORD, PA. — TULSA, OKLA.

LEADING ENGINE BUILDERS CHOOSE ENSIGN



Since 1911, ENSIGN has been continuously engaged in the manufacture of carburetors and in solving carburetion problems. This experience of more than a quarter-century has enabled us to perfect carbureting equipment unequalled for economy and efficiency, and accounts in a large measure for the fact that more than 90% of the leading engine manufacturers use ENSIGN products. If it's ENSIGN—it's the BEST!

WILSON Engine equipped with two ENSIGN Combination Updraft Gas and Gasoline Carburetors and an ENSIGN Fuel Regulator, is shown above. ENSIGN Carburetors are standard equipment at the Wilson factory.

ENSIGN CARBURETOR CO., LTD.

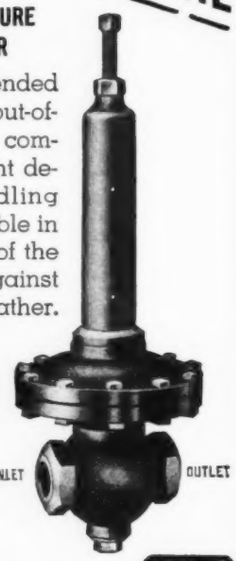
SAFEGUARDING PRESSURE

FULTON HIGH PRESSURE SPRING REGULATOR

Especially recommended for use in remote, out-of-the-way places. Its compact and light-weight design reduces handling and installation costs. Preferable in such places to a regulator of the lever type as it protects itself against tampering or injury by weather.

Equipped for high pressure, it reduces from 300 pounds to any desired pressure between 10 and 50 pounds.

Full information given in Bulletin 118.



Catalog on Request

THE CHAPLIN-FULTON MFG. CO.

28-40 Penn Ave. Pittsburgh, Pa.

CF

250-300 TON

Type 3B Regan Traveling Block

The supporting members in which the bearings are housed, and to which the load is transferred, are solid steel slabs, two inches thick. They contribute to the massive and rigid construction of the block and provide part of the weight which gives the block a free running movement in falling with no load.

Mid-Continent:
1502 Maury Street
Houston, Texas
Okla. and Kans. Rep.:
Bovaird Supply Co.
Tulsa and Wichita
New York City:
17 Battery Place
G. R. Woods, N. Y. Mgr.

Regan
Forge & Engineering Co.
San Pedro California

Injunction Obtained Against Second-Hand Oil-Well Equipment Dealer

As a result of the recent filing of a patent suit by Byron Jackson Company in the United States District Court at Oklahoma City, the defendants, McKee Supply Company and O. B. McKee, dealers in second-hand oil-well equipment at Oklahoma City, have been enjoined, pursuant to a consent degree, from continuing their practice of making-up for sale oil-well pipe and casing tongs employing parts of used Byron Jackson tongs, assembled with or without one or more parts made by the defendants. The decree finds that the defendants had infringed the patents of Byron Jackson Company as follows:

"By making and selling individual parts and elements of said tongs, with the intention that the same were to be assembled in pipe and casing tongs embodying and containing the inventions of said letters patent as set forth in said claims thereof; that said defendants have infringed said patents by purchasing or otherwise acquiring used or worn out pipe and casing tongs and parts thereof manufactured, assembled and sold by the plaintiff, and by disassembling said tongs and parts into their elements, and from the parts of different tongs so disassembled, constructing and selling complete tongs and tong heads; that said tongs and tong heads so constructed and sold by the defendants do not preserve the identity of any original tongs or tong heads manufactured, assembled and sold by the plaintiff; and that the defendants have infringed all of the claims of all of the said patents above named under the guise of repairing the tongs manufactured and sold by the plaintiff, by rebuilding worn out tongs, tong heads, and parts thereof, and selling the same."

In obtaining this injunction, Byron Jackson Company has invoked a remedy accorded by the patent laws, which, although well established by prior court decisions, has not heretofore been sought in the oil equipment industry. This action by Byron Jackson Company may be followed by similar action by other oil-field equipment manufacturers in an endeavor to protect their patented lines.

John McClain Heads New Chicago Office of Clark Bros.

JOHN McCLAIN

Clark Bros. Company, Olean, N. Y., announces the opening of a new office in the Peoples Gas Building, Chicago, Illinois. In charge of this office will be John McClain who will handle Clark engines and compressors in the Chicago area and in the states of Illinois, Indiana, and Michigan.

McClain has been associated in the gas and oil business for the last 15 years in a sales and engineering capacity and is well known to the petroleum industry.

New Warehouse for Wickwire Spencer

To improve the handling and distribution of Wickwire Rope to the Texas and Gulf Coast areas, Wickwire Spencer Steel Company, New York City, with sales offices and warehouses now in Abilene, Texas, and Tulsa, Oklahoma, has opened a new warehouse at 10 North Milby Street, Houston.

A complete line of rope stock of Standard and Wisscolay Preformed constructions is being maintained to include cable-tool and rotary-drilling lines.

Hazard Oldtimers

Talk that men past 40 have small chance in today's industry is largely based on the assumption that the elder workers

Back row, left to right: Philip Henry, 46 years of service; George Hoats, 67; Wally Schuler, 49; Pat O'Toole, 57. Front row: Pete Swinburne, 56; Hugh Murray, 50; Tony Blaum, 49; Bill McCarthy, 45. Not shown in this picture because their duties take them away from Wilkes-Barre are six other Hazard wire rope men: Fred Walters, with a service record of 56 years; Benjamin J. Hill, 49; Philip Schumacher, 47; George D. Wicks, 43; Robert A. Stucke, 41, and Fred Vogel, 40.

have been abandoned or shunted to the pension rolls before their days of productive labor are over.

A substantial argument in the negative has recently been provided by the Hazard Wire Rope Division of the American Chain and Cable Company, Inc., Wilkes-Barre, Pennsylvania. This wire rope company comes forward with the statement that its payroll carries the names of 14 employees, each with individual records of 40 to 67 years of service, these men collectively representing a total of 695 years of continuous employment with one organization.

O. D. Small Makes Extensive Trip

O. D. SMALL

O. D. Small, special sales representative for Portable Rig Company Inc., returned to Houston recently from a ten-month's tour of South American fields. Traveling via Miami Florida, to Trinidad, thence around South America and back to Miami. Small traveled most of the trip of nearly 30,000 miles by air.

Gotkool
WATER CANS
& COOLERS
GOTT Water Cans are the practical way to keep drinking water cool for long periods, protected from impurities and always handy to the job. Snug fitting large removable top, strongly built to withstand rough usage. GOTT Water Coolers have extra large covers and a handy non-leaking push button faucet. Your Supply Store has them, get one today! . . . . .
GOTT WATER CAN
Made in 1½, 2, 5, and 10 gallon sizes.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

Here...
Oakite Cleaning
RESTORED
Preheater Efficiency
WHEN in a large west coast refinery, preheater temperature dropped 15 degrees, prompt action was called for. The sudden drop followed a gradual lessening of efficiency over several months. Inspection revealed a hard coke-like deposit both outside and inside the tubes.
Under the direction of the near-by Oakite Service Men, the tubes were cleaned with two Oakite materials especially recommended for this kind of work. Results were startling. After the final rinse, tube surfaces were found to be 100% clean! A trial run showed a 20-degree rise, indicating heat transfer capacity had been fully restored.
Oakite cleaning experience can help you, too. Tell us your problem. Write. No obligation.
Manufactured only by
OAKITE PRODUCTS, INC., 48 Thames Street, New York, N. Y.
Branch Offices and Representatives in all Principal Cities of the U. S.
OAKITE certified CLEANING
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

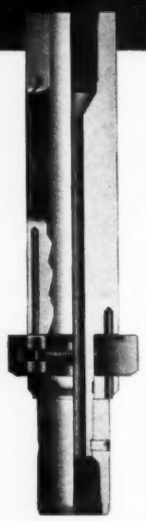
Mail Your Subscription Now

It's new!

CONTROLLED PACK-OFF

with the

SECURITY DELAYED ACTION PACKER SETTING TOOL



Now you can positively control the "packing-off" operations of Lead Seal Adapters and Lead Seal Liner Hangers with this new Security Device—the Delayed Action Packer Setting Tool.*

★ It eliminates all danger of accidentally expanding the Lead Seal when obstructions and tight spots are encountered while running in the hole.

★ It prevents the Seal from prematurely expanding when the hanger is set, thus assuring full circulation around the packer for cementing and washing operations.

★ It is unusually efficient in "scabbing off" damaged pipe, permitting a repair sleeve to be locked in place and both top and bottom packers set *independently*—all on one trip!

★ It is also useful for liner release, enabling the operator to know definitely, before starting out of the hole, whether or not the liner has been disengaged.

Get the complete dope on this efficient new Security Tool today. A request will bring a completely illustrated folder!

**Used in conjunction with the Security Left Hand Releasing Tool and Security Delayed Action Adapters and Liner Hangers.*

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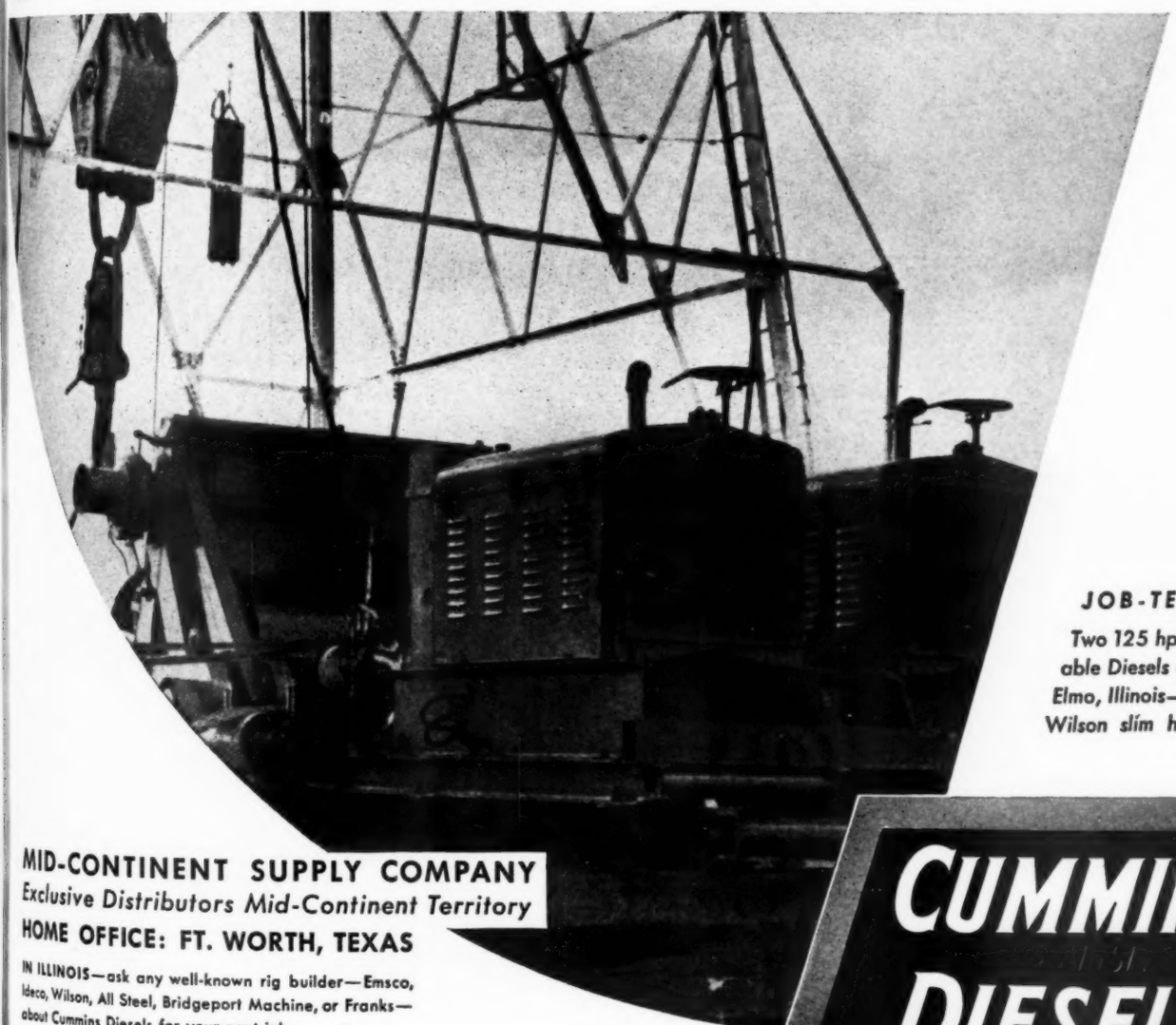

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